Reported skin cancer screening of US adult workers

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Background: Early detection of skin cancer by skin examination may reduce its associated morbidity and mortality, in particular for workers routinely exposed to sun.

Objectives: We sought to describe the proportion of US workers reporting skin cancer screening examination in a representative sample of the US worker population in the National Health Interview Survey.

Methods: Report of skin cancer examination in the 2000 and 2005 National Health Interview Survey cancer control supplements were examined by a range of variables.

Results: Lifetime and 12-month reported clinical skin examination prevalence was 15% and 8%, respectively. Workers with elevated occupational exposure to ultraviolet light were less likely to have ever received a skin examination than the average US worker. Logistic regression analysis identified occupational category and age, sex, race, education level, health insurance, and sun-protective behavior as significant independent correlates of skin cancer examination.

Limitations: A limitation is potential healthy worker effect and underestimation of skin cancer screening with self-reported data.

Conclusions: Routine examination by primary care physicians frequently does not include a thorough skin examination. Physicians should be even more vigilant with patients at increased risk of excessive occupational sun exposure, as early detection of skin cancer by periodic skin examination decreases morbidity and can improve survival. (J Am Acad Dermatol 2008;59:55-63.)

The dramatic increase in skin cancer incidence coupled with the central role of primary care physicians in cancer prevention and detection has led many to emphasize the importance of periodic skin cancer screening in routine primary care.[1] Skin cancer is the most common form of cancer in the United States with more than 1 million cases and approximately 10,850 deaths annually.[2-4] Although the majority of skin cancers are basal cell

Abbreviations used:

AAD:	American Academy of Dermatology
ACS:	American Cancer Society
NCHS:	National Center for Health Statistics
NHIS:	National Health Interview Survey
NIOSH:	National Institute on Occupational Safety and Health
NORA:	National Occupational Research Agenda
UV:	ultraviolet

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and squamous cell carcinomas (nonmelanoma skin cancer), the fatality rate of melanoma is high and its incidence has increased more than 15-fold since reliable data were first recorded in the 1930s.[5]

Sun and other ultraviolet (UV) light exposures have been implicated as a major causal factor in two thirds of skin cancer cases, particularly among some intense sun-exposure occupations as farming.[6,7] Solar radiation, and UV light in particular, are increasing worldwide with the thinning of the protective ozone layer.[2,8,9] The increasing incidence of skin cancer during the past several decades may be attributed to increased sun exposure associated with societal, occupational, and lifestyle shifts in the US population.

According to the governing principles of a worthwhile screening program, a disease considered for screening should have the following characteristics: high morbidity, mortality, costs, prevalence, and incidence; known natural history and biology; preclinical phase with high prevalence; and effective treatment of early-stage disease.[10] All 3 types of skin cancer possess all these characteristics: the prognosis for patients with early disease is excellent, early disease is often curable with simple surgical excision; therefore, early detection offers the opportunity to improve survival.[4,11-13] Skin cancer risk factors are well known, and the full-body skin examination as a skin cancer screening technique is safe, rapid, and easy to perform, making primary and secondary prevention obtainable and important.[14] Although evidence from randomized trials is nonconclusive, a case-control study suggested that skin self-examination may lower the melanoma-related mortality,[15] and a recent cohort study showed that a thorough skin examination increased the likelihood of identifying suspected melanoma.[16] Screening and early detection are vital, particularly when performed on populations or population subgroups at higher risk.

Specific recommendations regarding skin cancer screening differ among several health policy groups. Several organizations, such as the American Academy of Dermatology (AAD), the National Institutes of Health Consensus Conference on Early Melanoma, and the American Cancer Society (ACS) favor population-based screening, in addition to screening for high-risk groups. In 2000, the ACS recommended skin cancer examination as part of a cancer-related checkup every 3 years for people between 20 and 40 years of age, and annually for those older than 40 years[11,17,18]; in 2005, the ACS recommended skin cancer examination during a periodic examination by a physician for people aged 20 years and older (Table I).[19-22]

Because approximately 85% of the population sees a physician every 2 years, primary care physicians have an opportunity to provide cancer screening and preventive services as a result of the large volume of patients seen during routine health examinations.[23] Nevertheless, studies have demonstrated that total-body screening examinations are infrequently performed, even among potentially high-risk populations.[24-27] To evaluate the extent of skin cancer screening among US workers, we used the National Health Interview Survey (NHIS) data to estimate the percentage of US workers who had ever had a thorough skin examination and, among those who visited a primary health care provider in the past 12 months, to estimate the percentage that reported a skin examination during that period.

METHODS

Study population

The NHIS is an annual, cross-sectional in-person household survey of the US civilian noninstitutionalized population conducted by the National Center for Health Statistics (NCHS). The NHIS Cancer Control Module was administered in 2000 and 2005, and focuses on issues pertaining to knowledge and practices in cancer-related health behaviors. The NHIS Cancer Control Module is the only source of national population-based data on cancer screening. In 2000 and 2005, the Cancer Control Module included questions on clinical skin examinations that were administered to 19,702 and 18,422 employed participants, respectively. The conditional response rates to the 2000 and 2005 sample adult component of the NHIS (and for their Cancer Control Modules) were 82.6% and 80.1%, respectively, and the final response rates were 72.1% and 69%. Of the employed subsample adults, 96% and 94% responded to the specific skin screening question in 2000 and 2005, respectively (subsample N = 18,965 and 17,245, respectively).[28,29]

Variables

In both Cancer Control Modules, participants were asked: "Have you EVER had all of your skin from head to toe checked for cancer either by a dermatologist or some other kind of doctor?" The possible responses were: yes, no, refused, and don't know. Participants were also asked: "When did you have your MOST RECENT skin exam?" We grouped data of all participants who reported a skin examination from head to toe during: (1) the last 12 months; and (2) ever in their lifetime. Of note, only those individuals who also reported seeing a primary care physician or obstetrician/gynecologist in the past 12 months were included in the participants

Table I. Current and past American Cancer Society and US Preventive Services Task Force screening guidelines applicable during the 2000 and 2005 National Health Interview Cancer Control Module surveys

Advising body, publication year	Guidelines
ACS, 2000	Examinations every 3 y from ages 20 to 39 y and annually after age 40 y; cancer-related checkup should include examination for cancers of the. . .skin
ACS, 2005	On the occasion of a periodic health examination, the cancer-related checkup should include: examination for checkup cancers of the. . .skin
ACS, 2007	Same as ACS 2005
USPSTF, 1995	There is insufficient evidence to recommend for or against either routine screening for skin cancer by primary care providers. . . A recommendation to consider referring patients at substantially increased risk of malignant melanoma to skin cancer specialists for evaluation and surveillance may be made on other grounds
USPSTF, current (updated 2001)	The evidence is insufficient to recommend for or against routine screening for skin cancer using a total-body skin examination for the early detection of cutaneous melanoma, basal cell cancer, or squamous cell skin cancer

ACS, American Cancer Society; *USPSTS*, US Preventive Services Task Force.

reporting a skin examination in the past 12 months; all participants, regardless of seeing a physician in the past 12 months, were included in the group reporting a skin examination in their lifetime.

In the Cancer Control Modules, participants were also asked about their sun-protection behavior if they reported going out in the sun for an hour or more; those who responded "yes" were considered sun exposed for the purposes of this study. Among sun-exposed participants, any participant who reported one or more of the following behaviors was considered to be using sun protection for the purposes of this study: (1) wearing a hat that shades neck and face; (2) wearing a long-sleeved shirt; and/or (3) using sunscreen.

Detailed employment information coded by occupation and industry was collected on all individuals aged 18 years or older reporting working (paid and unpaid) during the week before the NHIS.[30] This permitted a classification based on 2000 US Census codes using a 4-category occupational status variable commonly used by the NCHS that included the categories of white-collar workers (census codes 003-389); service workers (403-469); farming, fishing, and forestry workers (473-499); and blue-collar workers (503-889). We also grouped workers into 8 industrial sector classifications that are now the focus of the National Occupational Research Agenda (NORA) at the National Institute on Occupational Safety and Health (NIOSH): agriculture, forestry, and fishing; mining; construction; manufacturing; wholesale and retail trade; transportation, warehousing, and utilities; services; and health care and social assistance.[31-33] Of note, these industrial groupings ignore the type of work that is done in each sector such that each group may include workers engaged in both blue- and white-collar occupational activities. In 2000, 41 standardized occupational codes derived from more detailed US Census occupational codes were provided; these codes changed significantly in 2005, not allowing for "cross walk" between 2000 and 2005 with regard to detailed occupation. Therefore, a more detailed occupational coding was only presented for the 2000 data.

Statistical analysis

Because of the complex sample survey design, analyses were completed with a software package to take into account sample weights and design effects.[34] US worker population estimates were based on NHIS sampling weights and these estimates varied by nonresponse to specific screening questions. Screening prevalence is presented with standard errors and 95% confidence intervals for the combined 2000 and 2005 cancer modules for the overall sample, and for the NCHS occupational categories and the NORA industrial sectors. Lifetime and past year screening rates were calculated for 41 occupational categories using the 2000 data. Of note, the prevalence rates presented in Table II were not adjusted for age to communicate the actual burden of disease in the population; age adjustment uniformly increased the prevalence by 1% (data not shown). We performed logistic regression analysis for the combined 2000 and 2005 cancer module data including the following variables: age (continuous and dichotomous [<40 and ≥ 40 years]), sex, race (white, black, other), education ($<$, $=$, or >12 years), sun-protective behavior (as described above), and NCHS occupational status category. The study received an exempt approval from our human subjects committee.

Table II. Among those who reported seeing a health care provider in the past 12 months, the prevalence of US workers who also reported a skin examination in the past year evaluated from 2000 and 2005 Cancer Control Modules of the National Health Interview Survey

	2000 Cancer Control Module				2005 Cancer Control Module			
Occupational category	Sample size	Prevalence of 12-mo skin examination, %	95% CI	Estimated no. of workers not having a skin examination	Sample size	Prevalence of 12-mo skin examination, %	95% CI	Estimated no. of workers not having a skin examination
All workers	13,381	8.0	7.5-8.6	107,124,395	11,537	8.5	8.0-9.1	104,891,709
NCHS								
White collar	8690	9.7	9.0-10.4	61,377,587	7375	10.3	9.5-11.1	56,297,961
Service	1843	6.6	5.5-8.0	14,478,824	2050	6.1	5.1-7.3	18,384,555
Farm	240	5.8	3.1-10.6	2,650,816	59	1.6	0.0-10.5	875,289
Blue collar	2608	3.9	3.1-4.8	28,248,168	2053	4.9	3.9-6.1	25,856,684
NIOSH NORA								
Agriculture, forestry, fishing	250	4.2	2.0-8.6	2,888,469	116	13.6	7.7-23.0	1,460,679
Construction	584	5.2	3.6-7.3	7,584,447	590	5.6	4.0-7.7	8,771,279
Health care and social assistance	2112	10.2	8.8-11.9	13,605,211	1759	9.4	8.0-11.0	12,172,973
Manufacturing	1783	5.4	4.3-6.8	16,309,666	1270	7.8	6.3-9.5	12,376,201
Mining	40*	6.0	1.5-21.9	404,861	32*	17.8	7.0-38.3	322,017
Services	5287	9.7	8.9-10.7	37,438,554	5684	9.2	8.3-10.1	46,290,544
Transportation, warehousing, utilities	924	8.1	6.2-10.5	7,727,977	560	9.2	6.8-12.3	5,247,303
Wholesale and retail trade	2336	5.6	4.6-6.7	20,769,672	1538	6.6	5.3-8.2	14,954,065

Prevalence rates presented were not adjusted for age to communicate the actual burden of disease in the population.
CI, Confidence interval; *NCHS*, National Center for Health Statistics; *NIOSH*, National Institute on Occupational Safety and Health; *NORA*, National Occupational Research Agenda.
*Sample sizes < 45 participants should be considered unstable.

RESULTS

Among 38,124 total worker participants interviewed from the 2000 and 2005 Cancer Control Supplements, 26,225 (69%) reported seeing a primary care physician in the past 12 months; among these workers, 25,207 (96.1%) answered "yes" or "no" to having received a skin cancer screening. The prevalence of both lifetime and 12-month skin examinations was low (Tables II and III). Only 15% of all US workers reported ever receiving a skin examination during their lifetime; only 8% of those who had also seen a health care provider in the past year reported that they had received a skin examination during the past year. Averaged during 2000 and 2005, approximately 106 million workers reported never having received a skin examination in their lifetime.

The 12-month skin examination by occupational group (2000 and 2005 Cancer Control Module)

In the 2000 and 2005 Cancer Control Modules, the prevalence of 12-month skin examination among those who had seen a physician in the past 12 months was lowest among farm workers (5.8% and 1.6%, respectively) and blue-collar workers (3.9% and 4.9%, respectively) (Table II). Analysis by NIOSH-NORA industry sectors showed that agriculture, forestry, fishing, and construction workers reported the lowest rates of skin examination in 2000. Although the prevalence of agriculture, forestry, and fishing workers reporting a skin examination increased from 2000 to 2005 (4.2%-13.6%), the prevalence of skin examination among construction workers stayed essentially the same (5.2%-5.6%) (Table II).

The 12-month and lifetime skin examination by detailed occupational codes (2000 Cancer Control Module)

In the 2000 Cancer Control Module among the 41 occupational groups, a lifetime history of ever having received a skin examination among all workers ranged from 3% in forestry and fishing occupations to 32% of workers employed in the health-diagnosing occupations. Occupational groups at increased

Table III. Lifetime and previous 12-month self-reported medical skin cancer screening rates in 41 occupational groups (2000 Cancer Module of the National Health Interview Survey)

Occupation	Sample size	Estimated worker population	Rate ever had skin examination, %	Rate skin examination within past year, %
Total	18,965	123,958,606	15	8
Construction laborers*	140	903,160	8	0
Freight, stock, material handlers	565	3,842,088	5	3
Forestry and fishing occupations*	19†	119,016	3	0
Farm workers and other agricultural workers*	333	1,865,934	7	6
Machine operators/tenders, except precision	718	4,561,694	6	4
Mail and message distributing	126	807,290	6	2
Private household occupations	144	706,744	5	1
Fabricators, assemblers, inspectors, samplers	391	2,574,917	8	4
Construction and extractive trades	785	5,545,136	8	4
Material moving equipment operators	137	889,278	7	0
Precision production occupations	512	3,548,449	8	5
Food service	802	5,235,077	7	5
Mechanics and repairers	613	4,437,809	9	5
Health service	463	2,542,028	9	7
Computer equipment operators	38†	245,890	7	5
Motor vehicle operators	571	3,975,045	9	4
Other sales	873	5,843,526	10	6
Cleaning and building service	520	3,085,558	11	8
Farm operators and managers*	120	891,435	10	6
Other protective service occupations	153	918,247	13	6
Personal service	454	2,693,371	14	8
Other administrative support	1883	11,439,537	14	9
Other transportation except motor vehicles	36†	298,271	12	14
Police and firefighters	182	1,317,415	14	8
Financial records processing occupations	339	2,256,131	11	5
Natural mathematic/computer scientists	365	2,383,409	14	9
Supervisors and proprietors	581	3,924,582	15	6
Technologists, technicians except health	372	2,534,700	16	9
Management-related occupations	770	5,092,138	16	9
Engineers	283	2,015,133	16	9
Health technologists/technicians	273	1,756,138	17	11
Managers administrators, except public administration	1795	12,203,328	19	11
Writers, artists, entertainers, athletes	328	2,074,334	20	12
Secretaries, stenographers, and typists	394	2,389,848	18	11
Officials and administrators, public	113	759,220	17	12
Sales representatives, commodities and finance	604	4,179,348	23	13
Teachers, librarians, counselors	1090	7,034,597	21	12
Architects and surveyors	27†	153,838	25	6
Health-assessment/-treating occupations	494	3,269,480	22	12
Other professional specialty occupations	416	2,613,951	23	11
Health-diagnosing occupations	143	1,031,516	32	18

Previous 12-month self-reported medical skin cancer screening rates were calculated of those workers who visited a physician in the past year. Lifetime self-reported medical skin cancer screening rates were calculated using all employed participants. Sample sizes were based on total working population in National Health Interview Survey for 2000 Cancer Module.

*Occupation at high risk for sun exposure.

†Sample sizes < 45 participants should be considered unstable.

risk for job exposure to UV light were less likely to have ever received a lifetime skin examination than the average US worker, including: farm operators and managers (10%), farm workers and other agricultural workers (7%), forestry and fishing occupations (3%), construction and extractive trades (8%), and construction laborers (8%), although some estimates were unstable because of small samples size (Table III).[35-37]

Prevalence rates for skin examination in the previous 12 months among workers with at least

Table IV. Among those who reported seeing a health care provider in the past 12 months, logistic regression analysis of the risk of having received a skin examination in the past 12 months (pooled data from 2000 and 2005 Cancer control Modules of the National Health Interview Survey)

	Multivariate adjusted OR (95% CI)		
Independent variables		**<40 y***	**≥40 y***
Age (continuous)			
Per year	1.04 (1.032, 1.040)		
Sex			
Male (reference category)	1.00	1.00	1.00
Female	0.90 (0.80, 0.99)	1.19 (0.94, 1.51)	0.80 (0.71, 0.90)
Race			
White (reference category)	1.00	1.00	1.00
Black	0.64 (0.52, 0.77)	0.73 (0.53, 1.01)	0.58 (0.46, 0.75)
Other	0.56 (0.41, 0.75)	0.63 (0.38, 1.03)	0.52 (0.36, 0.75)
Education			
<12 y (reference category)	1.00	1.00	1.00
12 y	1.11 (0.85, 1.45)	1.41 (0,81, 2.47)	1.01 (0.74, 1.39)
>12 y	1.90 (1.48, 2.44)	2.43 (1.45, 4.08)	1.70 (1.25, 2.32)
Health insurance			
No (reference category)	1.00	1.00	1.00
Yes	1.49 (1.19, 1.86)	1.50 (1.08, 2.08)	1.46 (1.07, 2.01)
Use sun protection			
No (reference category)	1.00		1.00
Yes	1.79 (1.55, 2.07)	1.76 (1.36, 2.27)	1.82 (1.53, 2.16)
NCHS occupation			
White-collar (reference category)	1.00	1.00	1.00
Service	0.84 (0.70, 0.99)	0.91 (0.69, 1.20)	0.80 (0.65, 1.00)
Farm	0.52 (0.26, 1.06)	0.55 (0.12, 2.47)	0.50 (0.23, 1.12)
Blue collar	0.54 (0.44, 0.65)	0.57 (0.39, 0.83)	0.53 (0.42, 0.66)

Overall pooled sample N = 24,535 (<40 y, sample N = 11,206; ≥40 y, sample N = 13,329).
CI, Confidence interval; *NCHS*, National Center for Health Statistics; *OR*, odds ratio.
*These analyses were performed with age as a dichotomous variable (ie, <40 vs ≥40 y).

one health care encounter during the same time period was highest among workers employed in the health-diagnosing occupations (18%). Workers employed as material equipment moving operators, construction workers, and forestry and fishing occupations reported less than 1% skin cancer examination rates in the previous 12 months.

Multivariable logistic regression analysis

The logistic regression analysis of the pooled data from the 2000 and 2005 Cancer Control Modules identified increasing age, male sex, white race, higher educational levels, having health insurance, and reporting the use of sun-protective behavior as significant independent factors for having received a skin cancer examination in the past year (Table IV). Having controlled for these factors, service, farm, and blue-collar workers compared with white-collar workers were significantly less likely to report having had a skin examination. When the population was divided by age younger than 40 years and 40 years or older, the patterns were similar (particularly for the subpopulation aged ≥ 40 years), although sometimes with less statistical significance caused in part by a decreased sample size. Of interest, the effect of increasing education was particularly strong for the population younger than 40 years (education > 12 years; odds ratio = 2.43; 95% confidence interval = 1.45, 4.08).

DISCUSSION

Of 32,210 total US worker participants interviewed in 2000 and 2005 for whom screening information was available, 70% reported seeing a physician in the past 12 months, whereas only 15% of these workers reported ever receiving a skin examination and only 8% received an examination in the past year. The rate of reporting skin cancer screening was lowest for high-risk occupations most likely to experience increased sun exposures. Occupational category and age, sex, race, education level, health insurance, and sun-protective behavior

were significant predictors of having a skin examination in the past year. Younger black or Hispanic women with no health insurance, who were service, farm, or blue-collar workers, and who did not use sun protection were the least likely to report ever having been screened for skin cancer. This is in concordance with the results of other reports of cancer screening.[38,39]

Although the logistic regression analysis revealed the inverse association between blue-collar, farming, and service occupations and the rate of skin examination, the rates of screening in Table II demonstrate the actual public health burden. In the year 2000 population of an estimated 128,480,200 US workers, an estimated 80,186,466 workers who saw a health care provider reported not having received a skin cancer screening in the past 12 months. These are important results because recent research has demonstrated that even among workers with occupational high UV exposure, preventive practices are highly variable with few education and prevention policies in place in US workplaces.[36]

Limitations

The NHIS prevalence rates were based on self-report. It is possible that participants were unaware of having received a skin cancer screening and, thus, the rate of screening might have been underestimated. However, self-reported whole-body skin examination has been validated in one study that reported a sensitivity of 90.5%.[40] Studies have found the quality of doctor-patient communications is lower among patients who are less educated.[41] Therefore, a possible explanation for the lower rates of skin cancer screening among many of the blue-collar occupational groups may be the communication challenges posed by differences in educational attainment between patient and health care provider. However, even after adjustment for educational level, the service, farming, and blue-collar workers were still significantly less likely to report skin cancer screening.

The NHIS uses information on the 1-week period before the survey for identification of occupation. Thus, individuals who did not work for the 1-week period before the survey are classified as unemployed, and there may be misclassification of some workers who were on vacation, sick, or on some other short-term leave from their jobs. Another limitation related to the use of the 1-week period before the survey is that the job worked for the past 1 week may not represent the longest or most important occupation during the lifetime of the individual. However, a previous study of the NHIS demonstrated a moderate to high agreement between current job and longest job held.[42] In that study, 70% of occupational groups in the 13 occupational categories had Kappa values greater than or equal to 50 with regard to agreement between their current and longest-held job. Nevertheless, this information on the working population is important as certain occupations experience constant high UV light exposure during their working life and, hence, an increased risk of skin cancer.[35-37] Prevalence rates of skin cancer screening in those high-risk populations were even lower than the average rate even among those who actually saw a physician.

Of note, the guidelines refer to a periodic skin examination; while using the NHIS data, we defined our variable as an examination in the last 12 months or "ever" skin examination. Yet it can be assumed that the results are not much different from the rate of periodic examination, as the rate of ever having a skin examination was relatively similar to that of having an examination in the last 12 months.

Conclusions

Recommendations from the ACS regarding screening for skin cancer include periodic skin cancer screening of people aged 20 years and older, and health counseling about occupational exposures.[20] Skin examination by a health care provider on the occasion of a health examination, particularly among adult workers with high occupational sun exposure, can be preventative and curative for various types of skin cancer. However, routine examinations by primary care physicians and other health care providers frequently do not include a thorough skin examination. The rates of reporting screening skin examination in other studies range from 14.5% to 34%.[38,39] The AAD and the American Medical Association have both provided brief review articles educating primary care physicians on efficient skin examination procedures for the office setting.[43]

Approximately 30% of workers in this study reported no contact with the health care system in the previous 12 months, and workers without health insurance were at significant risk of not reporting a skin examination in the past 12 months or ever in their life. Therefore, recent declines in worker health insurance coverage will unfortunately ensure that millions of workers will continue to not receive skin examinations and other essential preventive services by primary health care providers.[44,45] The results provided in this study could be used by public health officials, with the support of primary care physicians and other health care providers, to develop and implement local community health fairs specifically targeting the delivery of mass screening programs,

and programs targeting high-risk US worker groups (eg, construction, forestry, fishing, and farming workers) reporting low skin examination rates. Because they are community and worksite based, these programs could also be used to promote awareness and encourage access for US working adults to visit their primary care physician for general routine screening examinations. The combination of increased workplace and primary care office based and occupation-specific skin cancer screening is needed to effectively address the skin cancer burden in the United States.

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