Public Health Briefs

Who Is Being Screened for Cervical Cancer?

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Abstract: Data from the 1973 National Health Interview Survey, a probability sample of the United States population, are used to examine the relationship between Pap testing and four socioeconomic variables. It was found that women at highest risk of cervical cancer are least likely to have had Pap tests. The proportion of women who report never having had a Pap test is greater among Blacks, the poor, the elderly and nonmetropolitan residents. In particular, poor Black women in nonmetropolitan areas have extremely high proportions reporting no Pap test. However, high risk women are only slightly less likely to have visited a doctor in the two years preceding interview. These results suggest that improvement in Pap test coverage among high risk women could be attained by encouraging the use of the Pap test in regular ambulatory medical care. (*Am J Public Health* 1981; 71:73-76.)

Introduction

Although cervical cancer is not a major cause of death among United States women, it has been suggested that virtually all such deaths are preventable.[1] Yet in 1977, 5,166 American women died from cervical cancer. The basic approach to prevention involves cytologic screening using the Papanicolaou (Pap) test.

There is considerable controversy in the literature concerning the cost/effectiveness of this screening procedure.[2-4]

Much of the debate centers around the appropriateness of a *routine annual* Pap test for women at *low risk* of cervical cancer. Even critics of the test, however, would probably concede that periodic screening at intervals appropriate to a woman's risk profile should be carried out. Studies in selected communities have shown that women at highest risk are least likely to participate in screening programs.[5-7] This paper presents data from a national probability sample which support this observation.

Methodology

The National Health Interview Survey (NHIS) is an annual probability sample of the noninstitutional population of the United States. In 1973, NHIS included a battery of questions about the use of medical procedures associated with preventive care.[8] One set of questions concerned the use of Pap tests. Due to the questionable reliability of the reported frequency of Pap tests[7] this paper presents data only on the proportion of women who reported never having had a Pap test.

Cervical cancer has been associated with age, race, socioeconomic status, religion, and sexual habits.[9] Information on age, race, and income was available from the NHIS questionnaire to identify individual risk factors. In addition, metropolitan residence was used to add an area-wide planning perspective to the analysis. The 1968-72 age-adjusted cervical cancer death rates (age 35-74) for nonmetropolitan residents were 22 per cent higher for White women and 18 per cent higher for Black women than the rates for metropolitan residents. Thus, it is of interest to determine whether there were also screening differentials by residence.

It is important to remember that these results are based on respondent's report of having had a Pap test. Since income and education are correlated and since educated women may be more aware than the less educated of receiving a Pap test in the course of a routine medical examination, the possibility of reporting bias should be considered. Nonetheless, even if some of the women who report no Pap test have

actually received one, their ignorance of this fact is itself a barrier to effective preventive care.

Three age groups (25-44, 45-64, 65 and over) and two income groups (poor, nonpoor) were used. The income cut-offs for the poverty group were made to be as consistent as possible with the official Census Bureau definition ($3,000 for family size 2, $4,000 for 3, $5,000 for 4, $6,000 for 5, and $7,000 for family of 6 or more).

Thus four "independent" variables (age, income, residence, and race) were used to form a 3×2×2×2 table. The dependent variable was the proportion of women (within each cell) who reported never having had a Pap test. A logit model was used to analyze the data.[10] This approach is analogous to the analysis of variance (ANOVA) in that a linear model is assumed. In this case, however, the dependent variable is transformed to the logarithm of the odds (called a logit). The model can be written

$$\log\left(\frac{P_{ijkl}}{1 - P_{ijkl}}\right) = \lambda + \lambda_i^A + \lambda_j^I + \lambda_k^M + \lambda_l^R + \lambda_{ij}^{AI} + \lambda_{ik}^{AM}$$
$$+ \lambda_{il}^{AR} + \lambda_{jk}^{IM} + \lambda_{jl}^{IR} + \lambda_{kl}^{MR} + \lambda_{ijk}^{AIM} + \lambda_{ijl}^{AIR}$$
$$+ \lambda_{jkl}^{IMR} + \lambda_{ijkl}^{AIMR}$$

where P_{ijkl} = proportion of women with no Pap test in age group i, income j, residence k, race l
A = age (25-44, 45-64, 65+)
I = income (poor, nonpoor)
M = residence (metropolitan, nonmetropolitan)
R = race (White, Black)

The λ's are parameters reflecting the main effects and interactions of the independent variables. Just as in the ANOVA

they sum to zero over any subscript. The effect for a particular variable is expressed as an odds ratio, e.g., $e^{\lambda_k^M}$.

Model fitting and parameter estimation were carried out using the BMD-P program for log-linear models. Since we considered proportion screened as a dependent variable, only models with the AIMR margin fixed were tested.[10]

The approach used was hierarchical in the sense that a high order interaction is included only if all lower order terms involving that interaction are also included. This implies that first the four-factor interaction is tested to determine whether it is statistically significant. If not, the three-factor interactions are the tested, etc. The process stops when no more terms can be eliminated from the model (i.e., all remaining terms are significantly different from zero).

Since the NHIS is based on a complex sampling plan, the assumption that the data are drawn as a simple random sample is not strictly satisfied. However, research on the applicability of contingency table methods to complex survey designs suggests that the usual chi-square statistic can be divided by a design effect to obtain an approximate test statistic.[11, 12] The NHIS is a nearly self-weighting sample with a design effect of about two. Thus, the data presented here are unweighted (weighted proportions were very similar) and the chi-square statistics are divided by two. Since the chi-square statistics are only approximations, the 10 per cent significance level was used for model building.

Results

Table 1 shows the proportion of women who reported never having had a Pap test by age, income, residence,

TABLE 1—Per Cent of Women Who Report Never Having Had a Pap Test by Age, Race, Income and Residence: United States, 1973

		White			Black	
Age, Residence, Income	N	Observed Per Cent	Fitted[a] Per Cent	N	Observed Per Cent	Fitted[a] Per Cent
25-44 years						
Metropolitan Areas[b]	9159	6.8	—	1233	8.9	—
Poor	593	13.0	13.0	401	14.2	14.4
Nonpoor	8072	5.9	5.5	748	6.3	8.6
Nonmetropolitan Areas[b]	4055	7.3	—	306	25.8	—
Poor	450	14.0	15.2	135	30.4	26.0
Nonpoor	3397	6.2	6.5	142	16.9	16.4
45-64 years						
Metropolitan Areas[b]	7636	15.0	—	868	26.3	—
Poor	539	30.2	29.5	258	33.3	32.1
Nonpoor	6505	13.2	13.9	521	23.3	20.6
Nonmetropolitan Areas[b]	3638	19.9	—	264	42.8	—
Poor	488	32.8	33.4	127	46.5	49.7
Nonpoor	2852	17.2	16.2	116	37.9	35.2
65 years and over						
Metropolitan Areas[b]	3779	40.0	—	305	50.5	—
Poor	948	47.4	47.2	136	51.5	50.1
Nonpoor	2447	36.9	36.4	133	47.4	47.9
Nonmetropolitan Areas[b]	2074	44.6	—	157	64.3	—
Poor	761	52.0	51.7	114	62.3	67.8
Nonpoor	1157	39.7	40.7	31	67.7	65.8

[a]Fitted to logit model by stepwise maximum likelihood procedure.
[b]Includes unknown income.

TABLE 2—Summary of Likelihood Ratio Chi-Square Statistics Used in Model Building[a]

Hypothesis tested[b]	df	X^2
1. No 4-way interaction	2	0.35
2. No 3-way interactions	7	6.52
3. $\lambda^{IM} = \lambda^{MA} = \lambda^{AR} = 0$	5	3.15
4. $\lambda^{IA} = 0$	2	21.08
5. $\lambda^{IR} = 0$	1	5.62
6. $\lambda^{MR} = 0$	1	12.71

[a]Model building was done sequentially eliminating the least significant term at each stage. The above statistics combine several steps of the procedure. As noted in the text each X^2 value was divided by two to approximate the survey design effect. Goodness-of-fit for final model was X^2 = 10.02, 14 df.

[b]Hypotheses 1–3 are tested conditional upon the truth of the preceding hypotheses. Hypotheses 4–6 are tested conditional upon 1–3 being true.

and race. Application of the stepwise procedure outlined previously resulted in a model with three significant interactions: age × income, race × income, and race × metropolitan residence (see Table 2). Fitted values under this model for the per cent reporting no Pap test are also shown in Table 1. The odds ratios discussed below (Table 3) are based upon these fitted values.

The interactions imply that the odds ratio for each variable depends upon the level of one or two of the other variables. In general, however, the most striking effect is the sharp increase in the proportion reporting no Pap test as age increases. Compared to those aged 25–44, women aged 45–64 were 2.8 times as likely to report no Pap test. Poor women aged 65 and over were 6.0 times as likely as poor women aged 25–44 to report no Pap test. For women who were not poor, the odds ratio jumped to 9.8.

Compared to metropolitan residents, women in nonmetropolitan areas were more likely to report no Pap test, especially among Blacks (the odds ratio increases from 1.20 for Whites to 2.09 for Blacks).

The income differential was greater among Whites than Blacks and in the two younger age groups compared to the

oldest. For White women the odds ratio comparing poor to nonpoor was 2.6 for ages 25–64 and 1.6 for ages 65 and over. Among Black women the corresponding odds ratios were 1.8 and 1.1. The greater odds ratios among White women are due in part to the higher income levels for the White nonpoor compared to the Black nonpoor.

For every combination of age, residence, and income, Blacks were more likely than Whites to report no Pap test, although the magnitude of the odds ratio varied. The odds ratios were about 74 per cent greater in nonmetropolitan compared to metropolitan areas and 44 per cent greater among the nonpoor.

A potential confounding variable which has not been taken into account in the preceding results is geographic region. Since over 90 per cent of Black nonmetropolitan residents live in the South, it is possible that the race × metropolitan residence interaction is really a Southern effect. To examine this question, Table 1 was constructed for the South only. The results were virtually identical to those for the entire United States. Thus there appears to be no difference in screening levels between the South and other regions.

In summary, it is evident that women at highest risk of cervical cancer have the lowest participation in screening. Over 25 per cent of poor Black women aged 25–44 living in nonmetropolitan areas report no Pap test compared to 6 per cent of White women who are not poor in the same age group. The corresponding ranges were from 50 per cent to 14 per cent among women aged 45–64 and 68 per cent to 36 per cent in the oldest age group.

Discussion

These findings based on national data are consistent with previous studies in selected communities showing less frequent Pap tests among women at highest risk of cervical cancer. The proportion of women who report never having had a Pap test is greater among Blacks, the poor, the elderly, and nonmetropolitan residents. Since the value of screening

TABLE 3—Odds Ratios from Final Model

Comparison	Category of Interacting Variables	Odds Ratio
Age 45–64 vs 25–44	Poor	2.80
	Nonpoor	2.79
Age 65+ vs 25–44	Poor	5.98
	Nonpoor	9.83
Nonmetro vs metro	White	1.20
	Black	2.09
Poor vs nonpoor	White 25–44	2.57
	White 45–64	2.59
	White 65+	1.56
	Black 25–44	1.79
	Black 45–64	1.82
	Black 65+	1.09
Black vs White	Poor-metro	1.13
	Nonpoor-metro	1.62
	Poor-nonmetro	1.96
	Nonpoor-nonmetro	2.82

for women over age 65 is doubtful (at least for those with previous negative Pap tests), these results suggest that more intensive effort is needed to encourage the use of Pap tests among middle-aged women, Blacks, and the poor. This need is particularly acute among poor Black women in non-metropolitan areas.

It has been suggested based on a study in New York City that much of the unscreened population could be reached by encouraging the use of Pap tests in the course of regular ambulatory health services.[5] It is of interest to note that nearly one-half of poor Black women aged 45-64 in non-metropolitan areas report never having a Pap test. Yet another question on the 1973 HIS shows that more than 75 per cent of this group had at least one doctor visit in the two years preceding interview. Furthermore, the variation by age, income, race, and residence in the proportion with no doctor visit in the past two years is negligible compared to the variation in the proportion with no Pap test. Thus a great deal of improvement in Pap test coverage among high risk women could be attained by incorporating the Pap test into regular ambulatory medical care.

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The Devil Speaks of Doctors

I've tried all the medical faculty: they can diagnose beautifully, they have the whole of your disease at their fingertips, but they've no idea how to cure you. There was an enthusiastic little student here, "You may die," says he, "but you'll know perfectly what disease you are dying of." And then what a way they have of sending you to specialists. "We only diagnose," they say, "but go to such-and-such a specialist, he'll cure you." The old doctor who used to cure all sorts of disease has completely disappeared. I assure you, now there are only specialists, and they all advertise in the newspapers. If anything is wrong with your nose, they send you to Paris: There, they say, there is a European specialist who cures noses. If you go to Paris, he'll look at your nose; "I can cure only your right nostril," he'll tell you, "for I don't cure the left nostril, that's not my specialty, but go to Vienna, there there's a specialist who will cure your left nostril."

Dostoievsky F: The Brothers Karamazov. First published in Russian, 1879-80.