Short Communication

Underreporting of Family History of Colon Cancer: Correlates and Implications[1]

Karen Glanz,[2] John Grove, Loïc Le Marchand, and Carolyn Gotay

Cancer Research Center of Hawaii [K. G., J. G., L. L. M., C. G.], and School of Public Health [J. G.], University of Hawaii, Honolulu, Hawaii 96813

Abstract

Scientific advances in cancer genetics, risk counseling, and management of high-risk individuals require information about familial cancer history. Because some people may not report, or may be unaware of, cancer in their families, it is important to examine the extent of underreporting of family history. We mailed a survey to first-degree relatives of patients with histologically confirmed diagnoses of colorectal cancer (CRC) before age 60 ($n = 426$, 77% response rate). Analyses examined the extent of underreporting of family history and its predictors (demographics, cancer characteristics, knowledge, and communication) and correlates (cancer worry, perceived risk). Logistic regression analysis was performed using generalized estimating equations to account for family clusters. Despite confirmed diagnosis of CRC in a parent or sibling, 25.4% of respondents reported having no first-degree relative with colon cancer. In multivariate models, the most significant predictor of awareness of a relative's CRC was the stage-at-diagnosis; also, males and those with low knowledge about colon cancer were significantly less aware. Awareness of a relative's CRC was associated with higher cancer worry and risk perception, and being a college graduate contributed independently to increased risk perception. Sole dependence on mailed self-administered questionnaires may lead to substantial underreporting of familial colon cancers, especially those that are *in situ* or localized.

Introduction

CRC[3] affects roughly 5% of Americans at some time in their lives and large bowel cancer represents 15% of all cancers (1). There is growing evidence that a family history of CRC is associated with increased risk for CRC (2–7). Recent molecular studies have led to the identification of genes associated with hereditary nonpolyposis colon cancer (8, 9) and to the development of genetic susceptibility testing for hereditary nonpolyposis colon cancer.

Most advances in cancer genetics depend on obtaining accurate information on family history. Cancer risk counseling, management of high-risk patients, and decisions about the appropriateness of predictive genetic testing also require information about familial cancer history. Because some people may not report, or may be unaware of, cancer in their families, it is important to understand whether and why people may underreport their family histories.

The accuracy of self-reported family history information has been examined for many diseases including cancers (10–15). Studies have found family history of melanoma to be often overreported (14, 16) and breast cancer family history to be very accurate (11–13). However, in the only two studies to date designed to detect underreporting, about one-quarter of those who had blood relatives with cancer documented in medical records did not report a family history (12, 17).

Few studies have reported on the accuracy of reports of family history of colon cancer or have included very small numbers of cases of CRC (15, 18–20). In this study, we explore the extent of underreporting of CRC family history and its predictors (demographics, cancer characteristics, knowledge, family communication) and correlates (cancer worry, perceived risk). We hypothesized that accurate reporting of CRC family history (awareness) would be predicted by certain demographic characteristics; by cancers diagnosed at an earlier age and in a more distant stage; by greater knowledge about CRC; and by greater family communication and social support. We further hypothesized that awareness of a FDR with colon cancer would be associated with higher levels of cancer worry and higher perceived risk.

Materials and Methods

Data Sources. Data reported here are from two sources: (*a*) a population-based case-control study of the genetic epidemiology of CRC (Ref. 7; the epidemiological survey); and (*b*) the "family survey of attitudes toward genetic testing for colon cancer" (the psychosocial survey). Relatives of case probands and control index persons of Caucasian, Japanese, and Hawaiian ethnicity who were originally identified for, and agreed to participate in, the epidemiological survey were invited to complete the psychosocial survey.

Case probands consisted of men and women, ages 60 and younger, diagnosed with invasive adenocarcinoma of the large bowel between 1987 and 1996 who were ascertained through the HTR and whose diagnoses were histologically confirmed. Cases were asked to identify parents, siblings, and adult children (over age 18) living in Hawaii. These family members were asked to complete a mailed epidemiological survey (85% response rate). Because the survey was part of a case-control study, the invitation did not state whether or not they were included because of a family history of colon cancer.

The psychosocial survey was a self-administered mail

Received 1/22/99; revised 4/30/99; accepted 5/4/99.
[1] Supported by Grant HG01241 from the National Human Genome Research Institute and Grant CA33619 from the National Cancer Institute.
[2] To whom requests for reprints should be addressed, at Cancer Research Center of Hawaii, University of Hawaii, 1236 Lauhala Street, Suite 406, Honolulu, HI 96813. Phone: (808) 586-3076; Fax: (808) 586-3077; E-mail: kglanz@hawaii.edu.
[3] The abbreviations used are: CRC, colorectal cancer; FDR, first-degree relative; HTR, Hawaii Tumor Registry.

survey of CRC-free relatives who completed the epidemiological survey. These analyses included all of the siblings and adult children of cases. All of them had a verified FDR with colon cancer and provided reports of FDR cancers (among parents and siblings). The total sample includes 426 people from 160 families (77% response rate).

Measures. Data collected from both the epidemiological and psychosocial surveys and the HTR data, were used in these analyses. Survey data included background information, reported family history of cancer, knowledge about cancer, family support and communication, cancer worry, and risk perception. Information about cancer characteristics of the probands was ascertained from the HTR. The theoretical foundation for the psychosocial constructs was the precaution adoption model (21), which is concerned with how individuals perceive threatening situations or hazards, and what factors influence them to engage in protective action or adaptive coping behaviors. According to the precaution adoption model, major determinants of beliefs about one's disease risk include personal experience with a threat (*e.g.*, a family member being diagnosed with a disease), risk perception, and information about a risk (21, 22).

Background factors included relationship to the proband (sibling or adult child), ethnicity, sex, age, education, and religion. Cancer characteristics for the proband's CRC included: the proband's age at diagnosis with CRC and the stage of the cancer at diagnosis.

Reported family history of cancer, or "awareness" was determined from reports about whether a parent and/or sibling had been diagnosed with cancer of the colon or other cancers (breast, ovary, lung, prostate, or other). All of the responses to "other" were examined and were recoded into the colon cancer category if they specified rectal, bowel, large bowel, intestinal, or colorectal. Because all of the respondents were known to have at least one confirmed FDR with CRC, a binary colon cancer awareness variable was created. Persons reporting no parent or sibling diagnosed with CRC were considered not aware, and those reporting one or more parent or sibling with CRC were classified as aware.

Knowledge about CRC was assessed with an 11-item measure of general knowledge of colon cancer ($\alpha = 0.59$) and a 10-item measure of knowledge of heredity and cancer ($\alpha = 0.78$; Ref. 23). Communication/social support was measured by asking how often respondents would talk to family members about serious problems, such as a major illness, and how many family members they could talk with about such problems. The cancer-related worry measure assessed the frequency of concerns and intrusive thoughts about getting colon cancer and was measured with a four-item scale ($\alpha = 0.77$; adapted from Ref. 24). Risk perception was measured by asking how high the respondents believed their chances of getting colon cancer or polyps were, compared with other people their age (two items, $\alpha = 0.92$).

Statistical Methods. After computing descriptive statistics for all of the variables, bivariate analyses were performed to examine the associations between independent variables and awareness and between awareness and cancer worry and risk perception, using t tests and contingency table analysis (χ^2 tests). Variables that were found to be significant or marginally significant ($P < 0.10$) were included in subsequent logistic regression analyses.

Because there were multiple observations within families, we used generalized estimating equations (25, 26), to obtain consistent estimates of regression coefficients and standard errors. Adjusted for background factors, the family intraclass correlation for awareness that a FDR has colon cancer has a value of 0.42.

Multiple logistic regression was used to assess the contributions of demographic variables, cancer characteristics of probands, and knowledge and communication variables to the binary measure of awareness of CRC. Independent variables that were nominal with more than two classes, such as ethnic group, were treated by creating a set of dummy variables for the classes, with one class (the comparison group) being the intercept (27); a multivariate Wald test was used to test for differences in the mean of the dependent variable across the different classes. Multivariate analyses proceeded in hierarchical fashion, testing blocks of covariates and independent variables in the following sequence: (*a*) demographic factors; (*b*) familial cancer characteristics; and (*c*) the combined model (both demographics and familial cancer characteristics). A final model was fit by adding the block of variables assessing knowledge and communication.

To examine the contribution of background factors, cancer characteristics, and awareness to concern about CRC, regression models were fit with cancer worry and risk perception as dependent variables. Finally, both bivariate and multivariate analyses were repeated excluding relatives of probands with *in situ* cancers ($n = 30$).

Results

Sample Characteristics. Respondents were siblings ($n = 274$, 64.3%) and adult children ($n = 152$, 35.7%) of 160 CRC probands living in Hawaii and were of Japanese (78.9%), Hawaiian/Part-Hawaiian (11.7%), or Caucasian (9.4%) ethnicity. The sample was 49.3% male, with a mean age of 50 years (range, 19–84 years). About one-third had no more than a high school education and 29.8% were college graduates. One-fourth indicated Protestant religious affiliation, 31.7% were Buddhist, and the remainder were Catholic (12.4%), other (13.6%), or no religion (17.4%). Almost all of the respondents (98.1%) were born in the United States. Although all of the respondents were known by us to have a sibling or parent with colon cancer, 25.4% indicated that they had no FDRs with colon cancer.

Factors Associated with Awareness of Colon Cancer in the Family: Bivariate Analyses. We compared the 25.4% of respondents who indicated that they did not have a parent or sibling with colon cancer (unaware) with those who were aware (Table 1). Awareness was not significantly related to relationship to the proband (sibling or child), ethnicity, religion, or age of the proband at diagnosis. Males and older persons tended to be unaware more often. Educational level and cancer stage were strongly associated with awareness in a stepwise manner. Those with higher knowledge scores, greater family communication, more cancer worry, and higher perceived risk were significantly more likely to report a FDR with colon cancer.

Multivariate Analyses: Predictors of Awareness. The major factor associated with awareness of a relative's cancer is the invasiveness of the cancer. The odds of being aware increased 7-fold if the cancer was localized rather than *in situ* and 20 times greater if the cancer was regional or distant. The other variable that reached statistical significance in the original multivariate models was respondent gender, with males being one-half as likely as females (odds ratio = 0.56; $P = 0.015$) to correctly report a FDR with colon cancer. Adding the block of variables reflecting knowledge and communication significantly improved the fit of the model (Wald $\chi^2 = 16.40$ with 4 degrees of freedom; $P < 0.005$), although only the partial odds

Table 1 Factors associated with awareness of colon cancer in the family: bivariate analyses (n = 426)

	Not aware (n = 108) n (%)	Aware (n = 318) n (%)	P
Demographic characteristics			
Relationship to proband		ns[a]	
Sibling	75 (27.4)	199 (72.6)	
Adult child	33 (21.7)	119 (78.3)	
Ethnicity		ns	
Japanese	81 (24.1)	255 (75.9)	
Hawaiian/Part-Hawaiian	17 (34.0)	33 (66.0)	
Caucasian	10 (25.0)	30 (75.0)	
Sex			0.08
Male	61 (29.0)	149 (71.0)	
Female	47 (21.8)	169 (78.2)	
Age (mean ± SD)	52.6 ± 17.5	49.2 ± 15.9	0.06
Education			0.01
High school graduate or less	46 (30.5)	105 (69.5)	
Some college	43 (29.5)	103 (70.5)	
College graduate or more	19 (15.1)	107 (84.9)	
Religion		ns	
Protestant	18 (17.1)	87 (82.9)	
Catholic	18 (34.6)	34 (65.4)	
Buddhist	37 (27.8)	96 (72.2)	
Other	16 (28.1)	41 (71.9)	
None	16 (21.9)	57 (78.1)	
Cancer characteristics of the proband			
Age at diagnosis (mean ± SD)	53.5 ± 5.5	52.7 ± 6.4	ns
Stage at diagnosis			0.001
In situ	23 (76.7)	7 (23.3)	
Localized	43 (30.3)	99 (69.7)	
Regional/Distant	34 (16.2)	176 (83.8)	
Knowledge, communication, and CRC concern			
Knowledge (mean ± SD)			
Knowledge score (colon cancer) (0–11)	6.38 ± 2.05	7.09 ± 1.75	0.00
Knowledge score (heredity and cancer) (0–10)	3.05 ± 2.55	3.76 ± 2.72	0.02
Communication and social support			
Family communication/Social support (talk often)	21 (19.4)	95 (29.9)	0.04
Family members to talk to (3 or more)	70 (64.8)	207 (65.1)	ns
Concern about colon cancer (mean ± SD)			
Cancer worry (1 = rarely/never to 4 = almost always)	1.33 ± 0.40	1.47 ± 0.46	0.01
Risk perception (1 = much lower to 5 = much higher)	2.92 ± 0.88	3.27 ± 0.91	0.00

[a] ns, not significant.

ratios for the variables sex, stage, and "knowledge of colon cancer" were significant, after adjusting for the other variables (Table 2).

Cancer Worry and Risk Perception as Correlates of Awareness. Exponential regression models were fit with cancer worry—as the dependent variable—and demographics, cancer characteristics, and awareness as independent variables. The strongest association with cancer worry was being aware that a relative had colon cancer. Awareness of an affected FDR multiplied the index by exp(0.1247) = 1.133, or an average increase of about 13% in the cancer worry index.

Multiple linear regression was also performed with risk perception as the dependent variable and demographics, cancer characteristics, and awareness as independent variables. In these regression models, only two variables were significant: (*a*) being a college graduate; and (*b*)awareness of a relative having colon cancer. The effect of having a college education increased perceived risk by at least as much as knowing that a first degree relative has colon cancer.

Results of Analyses Excluding Relatives of Probands with *in Situ* Cancers. We repeated both bivariate and multivariate analyses excluding relatives of probands with *in situ* cancers (n = 30). The results of these analyses were similar to those including the entire sample of relatives, with only minor changes in the levels of statistical significance and no change in the direction of observed associations.

Discussion

Although our study was not primarily designed to investigate awareness of familial colon cancer, the surprising finding that more than one-fourth of the respondents known to have a sibling or parent with CRC reported having no FDRs with CRC warranted further examination. Awareness was highly correlated within families. Caucasians, males, less educated persons, Catholics, and older respondents tended to be unaware more often. Those who were aware of a FDR's colon cancer were more knowledgeable about CRC and about heredity and reported more family and friend social support, more cancer worry, and higher perceived risk. When the relative's cancer was diagnosed at an earlier stage, a sibling or child was significantly less likely to be aware of it. Interestingly, ethnicity, age, religion, and education were no longer significant predictors after controlling for knowledge and stage-at-diagnosis.

The bivariate associations that we found between aware-

Table 2 Factors predicting awareness that a parent or sibling has colon cancer[a]

Variable	Odds ratio[b]	95% confidence interval	*P*
Demographic characteristics			
Relationship to proband			
Sibling *versus* child	1.54	0.34–6.98	0.57
Ethnicity (Caucasian = reference group)			
Japanese	1.08	0.30–3.92	0.90
Hawaiian	1.67	0.35–8.11	0.52
Sex: male *versus* female	0.61	0.38–0.99	0.04
Age (in decades)	0.74	0.48–1.12	0.16
Education (high school or less = reference)			
Some college	0.74	0.42–1.29	0.29
Graduated from college	1.64	0.75–3.56	0.22
Religion (other = reference group)			
Protestant	1.40	0.47–4.16	0.55
Catholic	0.52	0.15–1.82	0.30
Buddhist	0.98	0.35–2.80	0.97
None	1.00	0.33–3.03	0.99
Cancer characteristics of the proband			
Age at diagnosis	1.24	0.66–2.33	0.49
Stage at diagnosis (*in situ* = reference)			
Localized	7.48	2.02–27.66	0.003
Regional or distant	20.15	5.38–75.47	<0.001
Knowledge and communication			
Knowledge (colon cancer)	1.17	1.01–1.36	0.04
Knowledge (heredity and cancer)	1.07	0.96–1.19	0.20
Family communication	1.61	0.75–3.47	0.22
Number of family members to talk to	0.93	0.85–1.02	0.14

[a] Logistic regression results, using generalized estimating equations to adjust for within-cluster correlation, $n = 426$.
[b] Odds ratios compare those who report a FDR with colon cancer *versus* those who report no FDR with colon cancers.

ness and gender, age, and education are consistent with findings of several other recent studies (10, 15, 18, 19). However, none of these comparable reports reported multivariate analyses; therefore, it is difficult to rule out alternative explanations such as disproportionate age/sex/education distributions.

Underreporting of family history of CRC may be due to confusion or lack of awareness of a relative's cancer, lack of communication within families, or reluctance to report family history on a mailed survey. Research to date suggests that there may be large differences across cancer sites in the accuracy of reporting family history (10, 13, 18).

Some people may choose not to disclose a family history of cancer on a mailed questionnaire (19). If this is the case, such underreporting might be reduced in clinical settings where the family history is taken in writing and followed by an interview with a family physician, oncologist, or genetic counselor. Direct interviews with relatives and the use of diagnostic screening criteria have been shown to improve the accuracy of reporting family history in research on neurological and psychiatric conditions (28–30).

Even skillful interviewing, however, may be insufficient to address this problem. Both negative and positive family history should be verified through review of medical records or linkage to cancer registries. Still, it may not be possible to verify all of the negative family histories, if family members are geographically dispersed, estranged, or no longer alive.

In genetic epidemiology research, reporting bias in family history may not affect study results if under- or overreporting is equal across case and control groups (14, 18). However, in clinical medicine, failure to report family cancer history may lead to missed opportunities for surveillance and ultimately, to avoidable mortality (20). Thus, clear and accurate provider-patient communication and family communication are of paramount importance. Health professionals should stress the need for open family communication to CRC patients and emphasize that this information is important for other family members to make health decisions.

The accuracy of family health history information is central to advances in research and to the provision of clinical services, counseling, and patient education (31). As new studies continue to reveal the significance of family history as a significant predictor of susceptibility mutations for breast, ovarian (32), colon, and prostate cancers (33), this issue takes on increasing importance.

Acknowledgments

We acknowledge the contributions of Dr. Haiou Yang, Dr. Caryn Lerman, Rosemary Casey, Dr. Lue Ping Zhao, Maj Earle, Dr. Jana Hall, Susan Donlon, and Gwen Ramelb. We also thank personnel at the Hawaii Tumor Registry, Kaiser-Permanente Medical Center, Kuakini Medical Center, Straub Clinic and Hospital, Queen's Medical Center, and St. Francis Medical Center for their assistance.

References

1. Cohen, A. M., Shank, B., and Friedman, M. A. Colorectal cancer. *In:* V. T. DeVita, S. Hellman, and A. S. Rosenberg (eds.), Cancer: Principles and Practice of Oncology, Ed. 3, pp. 895–964. Philadelphia: J. B. Lippincott Co., 1989.

2. St. John, J. B., McDermott, F. T., Hopper, J. L., Debney, E. A., Johnson, W. R., and Hughes, E. S. Cancer risk in relatives of patients with common colorectal cancer. Ann. Int. Med., *118:* 785–790, 1993.

3. Bonelli, L., Martines, H., Conio, M., Bruzzi, P., and Aste, H. Family history of colorectal cancer as a risk factor for benign and malignant tumors of the large bowel. A case-control study. Int. J. Cancer, *41:* 513–517, 1988.

4. Kune, G. A., Kune, S., and Watson, L. F. The role of heredity in the etiology of large bowel cancer: data from the Melbourne colorectal cancer study. World J. Surg., *13:* 124–129, 1989.

5. Slattery, M. L., and Kerber, R. A. Family history of cancer and colon cancer risk: the Utah Population Database. J. Natl. Cancer Inst., *86:* 1618–1626, 1994.

6. Fuchs, C. S., Giovannucci, E. L., Colditz, G. A., Hunter, D. J., Speizer, F. E., and Willett, W. C. A prospective study of family history and the risk of colorectal cancer. N. Engl. J. Med., *331:* 1669–1674, 1994.

7. Le Marchand, L., Zhao, L. P., Quiaoit, F., Wilkens, L. R., and Kolonel, L. N. Family history and risk of colorectal cancer in the multiethnic population of Hawai'i. Am. J. Epidemiol., *144:* 1122–1128.

8. Fishel, R., Lescoe, M. K., Rao, M. R. S., Copeland, N. G., Jenkins, N. A., Garber, J., Kane, M., and Kolodner, R. The human mutator gene homolog *MSH2* and its association with hereditary nonpolyposis colon cancer. Cell *75:* 1027–1038, 1993.

9. Bronnor, C. E., Baker, S. M., Morrison, P. T., Warren, G., Smith, L. G., Lescoe, M. K., Kane, M., Earabino, C., Lipford, J., Lindblom, A., *et al.* Mutation in the DNA mismatch repair gene homologue *hMLH1* is associated with hereditary non-polyposis colon cancer. Nature (Lond.), *368:* 258–261, 1994.

10. Bergmann, M. M., Calle, E. E., Mervis, C. A., Miracle-McMahill, H. L., Thun, M. J., and Heath, C. W. Validitiy of self-reported cancers in a prospective cohort study in comparison with data from state cancer registries. Am. J. Epidemiol., *147:* 556–562, 1998.

11. Anton-Culver, H., Kurosaki, T., Taylor, T. H., Gildea, M., Brunner, D., and Bringman, D. Validation of family history of breast cancer and identification of the BRCA1 and other syndromes using a population-based cancer registry. Genet. Epidemiol., *13:* 193–205, 1996.

12. Winter, P. R., Wiesner, G. L., Finnegan, J., Bartels, D., LeRoy, B., Chen, P. L., and Sellers, T. A. Notification of a family history of breast cancer: issues of privacy and confidentiality. Am. J. Med. Genet., *66:* 1–6, 1996.

13. Theis, B., Boyd, N., Lockwood, G., and Tritchler, D. Accuracy of family cancer history in breast cancer patients. Eur. J. Cancer (Phila.) Prev., *3:* 321–327, 1994.

14. Aitken, J. F., Youl, P., Green, A., MacLennan, R., and Martin, N. G. Accuracy of case-reported family history of melanoma in Queensland, Australia. Melanoma Res., *6:* 313–317, 1996.

15. Aitken, J., Bain, C., Ward, M., Siskind, V., and MacLennan, R. How accurate is self-reported family history of colorectal cancer? Am. J. Epidemiol., *141:* 863–871, 1995.

16. Weinstock, M., and Grodsky, G. L. Bias in the association of family history of melanoma with dysplastic nevus risk. J. Invest. Dermatol., *108:* 369, 1997.

17. Paganini-Hill, A., and Chao, A. Accuracy of recall of hip fracture, heart attack, and cancer: a comparison of postal survey data and medical records. Am. J. Epidemiol., *123:* 894–900, 1993.

18. Kerber, R. A., and Slattery, M. L. Comparison of self-reported and database-linked family history of cancer data in a case-control study. Am. J. Epidemiol., *146:* 244–248, 1997.

19. Schrijvers, C. T. M., Stronks, K., van de Mheen, D. H., Coebergh, J. W., and Mackenbach, J. P. Validation of cancer prevalence data from a postal survey by comparison with cancer registry records. Am. J. Epidemiol., *139:* 408–414, 1994.

20. Macrae, F. A., St John, D. J., Muir, E. P., Penfold, J. C., and Cuthbertson, A. M. Impact of a hospital-based register on the management of familial adenomatous polyposis. Med. J. Aust., *151:* 552–557, 1989.

21. Weinstein, N. D. The precaution adoption process. Health Psychol. *7:* 355–386, 1988.

22. Weinstein, N. D. Effects of personal experience on self-protective behavior. Psychol. Bull. *105:* 31–50, 1989.

23. Nunnally, J., and Bernstein, I. Psychometic Theory, Ed. 3. New York: McGraw-Hill, 1994.

24. Lerman, C., Daly, M., Masny, A., and Balshem, A. Attitudes about genetic testing for breast-ovarian cancer susceptibility. J. Clin. Oncol., *12:* 843–850, 1994.

25. Liang, K-Y., and Zeger, S. L. Longitudinal data analysis using generalized linear models. Biometrika, *73:* 13–22, 1986.

26. Diggle, P. J., Liang, K-Y., and Zeger, S. L. Analysis of Longitudinal Data. Oxford, United Kingdom: Oxford University Press, 1994.

27. Hosmer, D. W., and Lemeshow, S. Applied Logistic Regression, p. 307. New York: John Wiley, 1989.

28. Busenbark, K., Barnes, P., Lyons, K., Ince, D., Villagra, F., and Koller, W. C. Accuracy of reported family histories of essential tremor. Neurology, *47:* 264–265, 1996.

29. Li, G., Silverman, J. M., Smith, C. J., Zaccario, M. L., Wentzel-Bell, C., Siever, L. J., Mohs, R. C., and Davis, K. L. Validity of the family history method for identifying schizophrenia-related disorders. Psychiatry Res., *70:* 39–48, 1997.

30. Andreasen, N. C., Endicott, J., Spitzer, R., and Winokur, G. The family history method using diagnostic criteria: reliability and validity. Arch. Gen. Psychiatry, *34:* 1229–1235, 1977.

31. Pyeritz, R. E. Family history and genetic risk factors: forward to the future. J. Am. Med. Assoc., *278:* 1284–1285, 1997.

32. Shattuck-Eidens, D., Oliphant, A., McClure, M., McBride, C., Gupte, J., Rubano, T., Pruss, D., Tavtigian, S. V., Teng, D. H., Adey, N., Staebell, M., Gumpper, K., Lundstrom, R., Hulick, M., Kelly, M., Holmen, J., Lingenfelter, B., Manley, S., Fujimura, F., Luce, M., Ward, B., Cannon-Albright, L., Steele, L., Offit, K., Thomas, A., *et al.* BRCA1 sequence analysis in women at high risk for susceptibility mutations: risk factor analysis and implications for genetic testing. J. Am. Med. Assoc., *278:* 1242–1250, 1997.

33. Groenberg, H., Issacs, S., Smith, J. R., Carpten, J. D., Bova, G. S., Freije, D., Xu, J., Meyers, D. A., Collins, F. S., Trent, J. M., Walsh, P. C., and Isaacs, W. B. Characteristics of prostate cancer in families potentially linked to the hereditary prostate cancer (HPC1) locus. J. Am. Med. Assoc., *278:* 1251–1255, 1997.

Underreporting of Family History of Colon Cancer: Correlates and Implications

Karen Glanz, John Grove, Loïc Le Marchand, et al.

Cancer Epidemiol Biomarkers Prev 1999;8:635-639.