Accuracy of Health Research Reported in the Popular Press: Breast Cancer and Mammography

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The print media's dissemination of health information is important in shaping public beliefs and possibly behavior. Print media reports, some of them conflicting, concerning breast cancer and mammography have been prominent, leading to an intense and confused public reaction. This investigation evaluated the accuracy of popular accounts of research pertaining to breast cancer and mammography appearing in magazines and newspapers during a 2-year period. The reports were evaluated in two ways: (a) the adequacy of the information provided for locating the cited piece of research and (b) the accuracy of the information conveyed about the research. For the latter analysis, discrepancies between the original scientific publication and the popular account were categorized. In 116 articles, there were 113 citations to a scientific study; 60 of these citations were traceable to the original source. Of these 60 traceable citations, 42 content-based inaccuracies were found. The results are discussed in terms of implications for communication between the scientific community and journalists.

The accurate dissemination of health information by the popular media is indispensable for shaping public health-related beliefs and, potentially, behavior. Health care consumers now take a more active role in their own health and have developed an increased interest in health information from popular literature (Barsky, 1988; Lunin, 1987; Rees, 1987). Thus, information acquired through easily obtainable sources has become more salient as individual choices and behaviors such as smoking, diet, and exercise are

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demonstrated to make important contributions to health status (Rees, 1987). The mass media hold promise for profound influences on health promotion because they can reach very large, although diverse and undifferentiated, audiences (Flora, Maibach, & Maccoby, 1989). The role of the print media, in particular, appears to be prominent. One investigation has shown that in response to the question, “Where do you get your most useful information about how to prevent illness and improve your health?,” the print media, including magazines, newspapers, pamphlets, and books were the source identified with a frequency second only to physicians (Meissner, Potosky, & Convissor, 1992).

Because breast cancer is a leading and increasing cause of death for women in the United States (Kessler, Feuer, & Brown, 1991), prevention, early detection, and treatment of this disease have become focal issues in women’s health. Consequently, reports of risk factors and new treatments for breast cancer and the benefits and risks of mammography have been particularly prominent in the media. This print information appears to be important for health care consumers. In a survey in Connecticut, about 80% of respondents rated newspapers and magazines as important sources for obtaining information about cancer (Sackmary, 1989). Furthermore, people who cite print media as their most useful source of information are significantly more likely to have heard of cancer screening procedures than are those who rely on their physicians as a source (Meissner et al., 1992).

However, a lack of clarity concerning breast cancer information has been introduced by disagreements surrounding the research findings described in many media reports. For instance, mammography screening has commonly been considered crucial for detecting breast cancer when it is at a stage with a high probability for successful treatment (Hamwi, 1990; Schifeling & Hamblin, 1991). However, a recent, large-scale investigation found that screening mammography did not reduce mortality for women under age 50 (A. B. Miller, Baines, To, & Wall, 1992). Not surprisingly, the public reaction to the media coverage of such studies has been intense and confused. It is likely that this confusion compromises the value of the print media as a health-education and health-promotion tool. One investigation studied how well a group of college students could understand media reports of health research on dietary cholesterol and heart disease, treatment for breast cancer, starch blockers, and drug treatment for heart disease. The overall rate of reader misunderstanding was close to 40% (Yeaton, Smith, & Rogers, 1990).

Ideally, the print media’s role in covering and “translating” scientific and medical findings is to do so accurately and without introducing further confusion. Despite the public’s reliance on health information in the media, it appears that there is a need for continuing education concerning breast cancer prevention. For example, fewer than half of the respondents to a large survey knew the mammography screening guidelines appropriate for someone their age (Bastani, Marcus, & Hollatz-Brown, 1991). Given the need for reliable, up-to-date knowledge, we evaluated the accuracy with which origi-
nal research reports pertaining to mammography and the prevention of breast cancer are presented in the popular print media.

Previous research assessing the accuracy of science reporting have commonly relied on the authors of cited studies to determine whether their own work was accurately represented in a popular article (Pulford, 1976; Tankard & Ryan, 1974). Yet, this method has been criticized because, by focusing on the accuracy as perceived by the scientist source, it is limited by the subjective nature of the task (McCall, 1988). Also, there is disagreement between scientists and journalists as to what actually constitutes an error (McCall, 1988). Rarely has an impartial investigator with a single coding scheme directly compared popular articles with the original sources to examine the accuracy of the information presented to the popular reader (McCall, 1988). We decided to use this seemingly more objective alternative procedure (suggested by Singer, 1990). Thus, we limited our investigation to articles in the popular media that referred to a published source, so strict comparisons of research publications versus their popular translations could be made by neutral raters. Furthermore, we restricted our definition of an error to include only those mistakes that truly compromised the intended message, ignoring disputable "mistakes" identified by scientists in previous research such as omitting the names of other investigators on a team or an article being too brief (Tankard & Ryan, 1974).

METHOD

Popular articles were identified by searches using NEXIS, the Reader’s Guide to Periodical Literature, and Abstracts International for the 2-year period from June 1, 1990 to May 31, 1992. Using these three wide-ranging and overlapping indexes provided a thorough sampling of the popular literature. Articles from every indexed magazine and pieces from four newspapers (The Chicago Tribune, The Los Angeles Times, The New York Times, and The Washington Post) pertaining to (a) risk factors for breast cancer and (b) prevention and early detection of breast cancer were selected. The four newspapers were chosen because they are prominent, widely circulating, and from different regions of the country. Selecting newspapers that are presumably of better quality than, for example, smaller local papers handicaps against finding errors and provides a representative picture of the quality of information that Americans typically consume. Every article produced by our search was read in its entirety. The articles included in the study were those that made one or more references to the findings of a scientific investigation. These were specific citations, for example, a statement such as, “a recent study at Harvard Medical School” as opposed to more general references such as, “research has shown.” From the information provided in the article, a systematic effort to locate a published account of the scientific investigation was undertaken. Common library search techniques were used
including searching computerized data bases such as PsycLIT and
MedExpress and conventional periodical indexes such as Current Contents.
For more obscure citations that could not be located in the medical and
scientific literature, we tried to contact cited investigators, institutions, or
organizations by telephone and mail.

The popular media reports were evaluated in two ways: (a) the adequacy
of the information provided for locating the original source and (b) the
accuracy of the information conveyed concerning the research. For the latter
analysis, the presence of discrepancies was noted and categorized in one of
10 ways: (a) a misleading title, (b) a shift in emphasis, (c) treating specula-
tion as fact, (d) erroneous information, (e) omitting other important results,
(f) omitting qualifications to findings, (g) omitting important aspects of the
research methods, (h) overgeneralizing findings, (i) inaccuracies due to
obtaining information from personal communications, and (j) other miscel-
lanious inaccuracies. In addition, blatant errors of fact were noted. In gen-
eral, only errors that held some relevance for the interpretation of the
findings were included. Inconsequential errors such as reporting the wrong
number of subjects or the wrong date of the study were not counted because
they were not considered inaccuracies that distorted the understanding of the
original research report.

Definitions of each of the 10 types of errors coded were adapted from
Singer (1990):

1. **Misleading title**: A title that misrepresents the meaning of a scientific
   investigation (e.g., a title that distorts or exaggerates the meaning of
   a study).

2. **Shift in emphasis**: The emphasis in the news story is substantially
different from that of the original research report (e.g., a popular
account is much more dramatic and optimistic than the original, or a
risk is exaggerated).

3. **Treating speculation as fact**: Treating as fact what is presented in the
   original article as speculation (e.g., when an original source prefaces
   a statement with, “these results suggest” or “it is possible that,” and
   this supposition is presented as fact).

4. **Erroneous information**: Factual errors that distort the meaning of the
   findings of a study (e.g., reporting a study’s subject population, re-
   sults, or conclusions erroneously).

5. **Omitting other important results**: Neglecting to mention findings that
   are important to a study’s meaning (e.g., citing the health benefits of
   a drug but not its risks).

6. **Omitting qualifications to findings**: Failing to mention qualifications
to findings discussed in a scientific report (e.g., limited generalizabil-
ity to a larger population).

7. **Omitting important aspects of the research methods**: Failing to report
aspects of research methods that are integral to the study’s meaning.
8. **Overgeneralizing findings**: Making generalizations to a larger population than is reasonable because the study sample is restricted in age, socioeconomic status, race, and so on (e.g., making recommendations to "women in general" from a study of young, middle-class, White women).

9. **Inaccuracies due to obtaining information from personal communications**: Attributing findings to a study that do not actually appear in the published manuscript, yet are attributed to a quote of one of the study's authors.

10. **Other miscellaneous inaccuracies**: Errors of fact that were not a result of the translation process from original source to popular article (e.g., positing that "mammograms prevent breast cancer" when in actuality, they can only detect it).

Each story was coded by two of three coders who made their evaluations independently and then reconciled any differences between their ratings with the arbitration of the third. Cohen's kappa coefficient of agreement adjusting for chance (Cohen, 1960) on the inaccuracies identified for a sample of 20 articles, coded without consultation, was .85.

**RESULTS AND DISCUSSION**

**Adequacy of Information for Locating Cited Research**

The search of the popular press for articles on the prevention and detection of breast cancer and mammography yielded 116 articles. Of these, 41 articles (35%) contained no citations to original research reports. Of the 75 articles that did make one or more references to an original scientific study, 40 articles (53%) contained one or more references that could not be traced to the original research. A total of 113 citations was made (note that each of the 75 articles with citations may have more than one citation). Of these 113 references, 60 (53%) could be traced to the original research publication.

The publications were divided into four types: (a) newspapers, (b) women's magazines (publications that focused on women's fashions or issues relevant to women; e.g., *Glamour*), (c) science magazines (periodicals that dealt with popular scientific issues; e.g., *Science News*), and (d) health magazines (publications that primarily reported on issues related to health; e.g., *Prevention*). Table 1 expresses the percentage of articles that did not make reference to a published study and the number of citations that could be traced to the original source broken down by type of print medium.

**Accuracy of the Information Conveyed**

Some illustrations follow of the 10 types of errors identified.
TABLE 1
Frequency and Percentage of Citations, Traceable Citations, and Inaccuracies by Type of Print Media

<table>
<thead>
<tr>
<th>Media Type</th>
<th>Articles Containing Citations/Total Articles (%)</th>
<th>Traceable Citations/Total Citations (%)</th>
<th>Traceable Citations With Inaccuracies/Total Traceable Citations (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>40/68 (59)</td>
<td>20/48 (42)</td>
<td>5/20 (25)</td>
</tr>
<tr>
<td>Women’s magazines</td>
<td>12/21 (57)</td>
<td>8/20 (40)</td>
<td>7/8 (88)</td>
</tr>
<tr>
<td>Science magazines</td>
<td>10/11 (91)</td>
<td>18/22 (82)</td>
<td>5/18 (28)</td>
</tr>
<tr>
<td>Health magazines</td>
<td>13/16 (81)</td>
<td>14/23 (61)</td>
<td>6/14 (42)</td>
</tr>
<tr>
<td>Total</td>
<td>75/116 (65)</td>
<td>60/113 (53)</td>
<td>23/60 (38)</td>
</tr>
</tbody>
</table>

**Misleading title.** The title, “Breast Cancer: A Formula for Prevention” (Stavish, 1990, p. 9) was coded as misleading. The article described a formula developed for projecting individualized probabilities of developing breast cancer. However, this risk calculation is based on factors that an individual has little control over, such as age, number of family members who have had cancer, and number of previous diagnostic breast biopsies (Gail et al., 1989). Thus, the formula has little relevance for prevention but simply describes risk. This emphasis on prediction rather than prevention is reflected in the title of the original source, “Projecting Individualized Probabilities.”

**Shift in emphasis.** One popular account (Raloff, 1990) relied heavily on the findings of a study that reported increases in the incidence of breast tumors with estrogen-positive receptors (Glass & Hoover, 1990). The investigators discussed their findings in terms of their possible link to the rise in breast cancer incidence but did not even speculate about diet as an intervening mechanism. The popular article, on the other hand, posited that the results are important for linking the rise in breast cancer to dietary fat. This argument is based on the observation that obesity can elevate estrogen levels in older women, making them more prone to estrogen-positive breast cancers. This supposition, combined with treating the speculations from another study on several dietary factors in breast cancer as conclusive, resulted in the description of the original study as concentrating on the role of fatty diets in breast cancer.

**Treating speculation as fact.** The following example from a study linking exercise to lowered breast cancer risk is a classic illustration of how the caution used in drawing conclusions in research reports is attenuated in the popular media. An original report noted:

Although one can only speculate at present as to the reasons for the lower risk, the most likely explanation in our view is that, in the long term, the former
athletes had lower levels of oestrogen because they were leaner and more of the oestrogen was metabolized to the non-potent catechol-oestrogens. (Frisch, 1987, p. 531)

The popular report treated this speculation as fact and, furthermore, became prescriptive.

A Harvard study of more than five thousand college graduates shows that women who have exercised all their life experience significantly lower levels of breast and reproductive cancers. The reason ... involves the apparent connection between estrogen balance and body fat—the lower the level of circulating estrogens in the bloodstream. Do an aerobic workout at least three times a week. (Royak-Schaler & Benderly, 1992, p. 274)

A similar example concerns the antiestrogen drug tamoxifen. The research article stated: “Thus, adjuvant tamoxifen may reduce cardiovascular disease and osteoporosis at the same time that it reduces the recurrence rates from breast cancer, a possibility suggested by early clinical data” (Henderson, 1990, p. 42). The popular article reported: “It [tamoxifen] also has other benefits. It reduces the risk of heart disease and possibly osteoporosis” (Siegel, 1991, p. 120). Parenthetically, this particular quote is attributed to the author of the scientific paper, apparently from a personal communication. This is an illustration of how it is often difficult to determine the origin of such an inaccuracy. It could be due either to journalist misunderstandings from personal communications with the researcher or to accidental misrepresentations by the researcher.

Erroneous information. Some forms of erroneous information were simple, yet misleading, inaccuracies in statistics. For example, a popular article describing a survey of mammography centers in New Jersey stated that “only 13 sites [of 202 mammography centers], or 6 percent, charged less than $100” (Friedland, 1991, p. 1). In actuality, a check of the survey itself revealed that 32 sites, or 16%, charged less than $100 (Starr, 1990).

Other types of erroneous information resulted in overstating or understating the results of a study. A popular press article reported that, “the study ... found that women with a form of benign breast disease called atypical hyperplasia are 3.7 times more likely than women in general to develop what has become the most common cancer in women [breast cancer]” (Scott, 1992, p. 3). A closer reading of the source indicates that the comparison group was not “women in general” but women with other types of benign breast disease that had not gone on to develop cancer (London, Connolly, Schnitt, & Colditz, 1992). Thus, this report probably underestimated the risk that women with atypical hyperplasia have for breast cancer in comparison to women in general because women with benign breast disease have, on average, a higher risk for breast cancer (Hutchinson et al., 1980).
Omitting other important results. A piece describing a study of dietary factors in breast cancer ("Eating to Beat," 1990) made reference only to the effects of reductions in saturated fats on breast cancer risks. It neglected to mention that significant results were also reported for reductions in total fats, consisting of saturated fat, monounsaturated fats, and polyunsaturated fats (Howe et al., 1990).

Omitting qualifications to findings. A popular report focusing on dietary factors cited a study that found differences in blood levels of beta-carotene, cholesterol, and triglyceride (a blood fat) between "83 women with breast cancer and 113 women without it" ("Bad to the Breast," 1991, p. 14). However, the control group, those without cancer, were all patients who had undergone a diagnostic breast biopsy (Potischman et al., 1991). Thus, the results generalize only to women without cancer who have some sort of benign breast condition, not to women without cancer in general, as the report suggested.

Omitting important aspects of the research methods. An example of omitting important aspects of a study's research methodology comes from one piece that discussed the link between body fat located on the torso, as opposed to the arms and legs, and risk for breast cancer. The article reported that "the associations seemed strongest for women who developed cancer after menopause" ("Where's Your Fat?" 1991, p. 15). But this report misrepresented the fact that age and menopausal status were examined separately. The scientific report said:

The relative risk estimate [for breast cancer] increased slightly and remained significant among older women and those who were postmenopausal at the time of skinfold measurement. The test for trend of this relationship [over four quartiles] was significant for older women (p < 0.05) and was near significance for postmenopausal women. (Ballard-Barbash et al., 1990, p. 288)

So, although postmenopausal women tend to be older, it appears that age, independent of menopausal status, was equally if not more important in the relation between fat distribution and cancer.

Overgeneralizing findings. An example of overgeneralizing of findings comes from an article that read:

What's your breast cancer risk? Mitchel H. Gail, M.D., a biostatistician, and his colleagues at the National Cancer Institute in Bethesda, Maryland, have identified four major factors: the number of first degree relatives, (sister or mother) who have had breast cancer; menstruation at an early age; delayed motherhood; and number of previous breast biopsies, even for benign conditions. Age itself
is a risk factor for cancer, and older women tend to have a higher risk. Below Dr. Gail has calculated breast-cancer risks for nine sample women to show how these factors interact. (Royak-Schaler & Benderly, 1992, p. 245)

The popular article did not mention the caveat that these statistics came from a sample of White, middle-class women participants in the decades-long Breast Cancer Detection Demonstration Project—all subjects were women who were willing to have annual examinations (Gail et al., 1989). Because the criteria for inclusion in the study mean that subjects are probably more compliant with medical care and because of the possible cohort effects of this older sample, the generalization of these findings to other groups of women, such as the magazine’s readers, may be dubious.

**Inaccuracies due to personal communications.** Some information seemingly or apparently came from an interview with one of the study’s authors. Often, however, this extra information was not reported in the scientific paper and could not be verified. For example, in describing a study on the effects of tamoxifen (an antiestrogen drug), one magazine article reported:

Tamoxifen lowered the women’s total blood cholesterol by 12% and slashed low-density lipoprotein cholesterol—the bad form that clogs arteries—by 20%. That translates into a 40% reduction in heart disease risk in postmenopausal women, according to Dr. Paul Carbone, director of the Wisconsin Comprehensive Cancer Center, one of the study’s authors. (Wartik, 1991, p. 10)

However, there was no documentation of blood cholesterol in the original research report. Although it is understandable that a time lag in publication means an investigator has relevant data that are not yet in print, when a popular article gives the impression that this was part of a published study, findings are misrepresented as work that has been peer-reviewed and accepted for publication.

**Other inaccuracies.** Other types of inaccuracies involve errors of fact that were cited in articles that did not come specifically from a research report. One cited incorrect screening guidelines: “The American Cancer Society suggests that women 35 to 39 years old receive mammograms every two years” (Lee, 1990, p. B1). The correct guideline at the time, that women 35 to 39 years of age should receive only a baseline mammogram, was communicated accurately in the original report (Office of the Comptroller, 1990).

In some cases, the errors are so apparent that original research is not needed to determine accuracy. In one example, there are multiple errors that compromise readers’ understanding of the purpose of mammography. The article stated that “according to studies in the Radiology Journal and other medical publications, mammograms falsely report malignant lumps to be
benign in about 10 to 15 percent of cases” (Kolata, 1991, p. 61). In this case, there is no periodical entitled Radiology Journal. Although this may represent a simple typographical error, a comprehensive search of the listed medical periodicals with similar names, such as Radiology, yielded no appropriate research. Thus, the information could not be traced to its source. The major problem was that the article stated that mammograms find malignancies, a blatant error. Mammograms can detect only abnormalities in the breast tissue. For a lump to be diagnosed as malignant, a biopsy must be performed and the tissue examined by a pathologist. The issue is whether suspicious lesions appear on the mammogram, not whether the mammogram determines malignancy.

The analysis identified 42 of these content-based inaccuracies contained in 24 articles. (Note that it is possible for a single citation to contain more than one inaccuracy—e.g., misleading title and omission of important results—although each inaccuracy could only occupy one category of error.) In the 24 articles that contained errors, the mean number of errors was 1.75 per article with a range from 1 to 4.

Table 2 indicates the frequency and rate of each class of inaccuracy by media type. A shift in emphasis was the least frequent inaccuracy with only one case, and erroneous information was the most frequent with 10 cases. Newspapers were significantly less likely to contain errors than magazines in general, $\chi^2(1, N = 84) = 51.86, p < .001$, although this figure is tempered by the fact that newspapers articles, compared to other types of print media, contained a small number of citations, traceable or not. In general, newspaper errors clustered around erroneous information, and magazine errors were

<table>
<thead>
<tr>
<th>Type of Inaccuracy</th>
<th>Newspapers (%)</th>
<th>Women’s Magazines (%)</th>
<th>Science Magazines (%)</th>
<th>Health Magazines (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misleading title</td>
<td>0/6 (0)</td>
<td>0/11 (0)</td>
<td>2/10 (20)</td>
<td>2/15 (13)</td>
<td>4/42 (9)</td>
</tr>
<tr>
<td>Shift in emphasis</td>
<td>0/6 (0)</td>
<td>0/11 (0)</td>
<td>1/10 (10)</td>
<td>0/15 (0)</td>
<td>1/42 (2)</td>
</tr>
<tr>
<td>Treating speculation as fact</td>
<td>0/6 (0)</td>
<td>2/11 (18)</td>
<td>0/10 (0)</td>
<td>1/15 (6)</td>
<td>3/42 (7)</td>
</tr>
<tr>
<td>Erroneous information</td>
<td>5/6 (83)</td>
<td>2/11 (18)</td>
<td>1/10 (20)</td>
<td>2/15 (13)</td>
<td>10/42 (24)</td>
</tr>
<tr>
<td>Omitting other important results</td>
<td>0/6 (0)</td>
<td>0/11 (0)</td>
<td>0/10 (0)</td>
<td>2/15 (13)</td>
<td>2/42 (5)</td>
</tr>
<tr>
<td>Omitting qualifications to findings</td>
<td>0/6 (0)</td>
<td>1/11 (9)</td>
<td>0/10 (0)</td>
<td>1/15 (6)</td>
<td>2/42 (5)</td>
</tr>
<tr>
<td>Omitting important aspects of methods</td>
<td>0/6 (0)</td>
<td>2/11 (18)</td>
<td>2/10 (20)</td>
<td>1/15 (6)</td>
<td>5/42 (12)</td>
</tr>
<tr>
<td>Overgeneralizing findings</td>
<td>0/6 (0)</td>
<td>2/11 (18)</td>
<td>2/10 (20)</td>
<td>2/15 (13)</td>
<td>6/42 (12)</td>
</tr>
<tr>
<td>Inaccuracies due to personal communications</td>
<td>0/6 (0)</td>
<td>2/11 (18)</td>
<td>3/10 (30)</td>
<td>0/15 (0)</td>
<td>5/42 (12)</td>
</tr>
<tr>
<td>Other, miscellaneous</td>
<td>1/6 (17)</td>
<td>0/11 (0)</td>
<td>0/10 (0)</td>
<td>4/15 (27)</td>
<td>5/42 (12)</td>
</tr>
</tbody>
</table>
distributed fairly evenly across categories. There was no significant correlation between length of article and number of inaccuracies.

These findings indicate substantial inaccuracy in the translation of health research into popular print. The most frequent type of error was the presentation of erroneous information. This kind of error may pose serious problems in misinforming and misleading the public. On the other hand, these inaccuracies appear unintentional and do not seem to result from a desire to sensationalize science, a criticism that has been previously leveled at health reporting in the news (Taylor, 1990). It is possible that scientists have overstated the distortion that accompanies scientist/journalist communications (McCall & Stocking, 1982). These inaccuracies seem likely to be the result of differences in the goals and the methods of journalists and scientists. Journalists must convey ideas and information in an engaging and entertaining manner, express complex information in a brief article, and face editorial pressures and deadlines (Engel, 1990). In addition, complicated facets of research such as statistics, sampling, and scientific principles germane to a particular piece of research may be difficult or too unwieldy to communicate effectively in a popular report (Yeaton et al., 1990). Moreover, newspapers and magazines are competitive, commercial ventures. As one former medical reporter explained:

The best of those who own, run, and work for [newspapers] recognize and, indeed, take very seriously, a function beyond simply making money. Nevertheless, the very nature of newspapers guarantees their own shortcomings. Under the constant pressure of time and events, newspapers can rarely maintain the continuity required for “education.” They are not designed to educate, but to inform and to entertain. (Hollobon, 1990, p. 1050)

In contrast, scientists and doctors, whose training may provide little understanding of journalism (Cameron, 1991), are concerned with factual issues (Dunwood, 1986; Friedman, 1986; for a review, see McCall, 1988). Furthermore, researchers may be inexperienced in expressing information to a lay audience and may not be given the opportunity to check the accuracy of a story before it goes to press. Thus, where possible, both scientists and journalists have a role to play in improving accuracy in health promotion.

Our results also suggest that the four newspapers we scanned reported scientific work more accurately than the magazines included in the study. This may be due to the fact that newspaper stories were often describing the newsworthy findings of just one investigation, but the magazines tended to feature more general topics in which the results of a study were used only to support a portion of the discussion. Thus, this more general level of description of the study may be responsible for more inaccuracies.

It is important to address some of the limitations of this study. First, the scientific merit of the research studies was not considered, mainly because scientific and medical research cited in the news media usually appears first
in respected peer-reviewed journals, so we considered this issue beyond the scope of our investigation. Second, we did not examine which topics were covered and not covered in the popular media and how representative these were of the concerns and focus of the scientific literature. This kind of analysis has been skillfully conducted for the reporting of social science in the national media (Weiss & Singer, 1988). Third, although our methodology was used to increase objectivity, determining whether an error actually compromises the understanding of an original research report is admittedly a subjective endeavor. Finally, this study provides little indication of how inaccuracies arise. An investigation that examined such things as press releases or other ways scientific research is obtained by authors of popular reports would provide better insight into the sources of errors.

Although many of these articles probably used information that originated from a scientific source, the absence of a citation precluded any examination of accuracy. Furthermore, where the information given to locate the original source was insufficient, we were also unable to evaluate the accuracy of the news stories. These inadequate citations made up a substantial portion (47%) of the total references made to original research. This being the case, our analysis may have severely underestimated the degree to which information is distorted. Finally, this investigation considered a select portion of the popular health literature (only articles that specifically made reference to a scientific investigation); thus, generalizations about the accuracy of other types of popular articles cannot be made.

Researchers and journalists must not underestimate their role in communicating health information to the general public. Because readers tend to trust scientific reports, inaccuracies can lead to serious misunderstandings (Flatow, O'Leary, Rodgers, Schneider, & Trotter, 1986). For example, the absence of traceable citations makes it nearly impossible for the average reader to ascertain the accuracy of a popular article or to obtain the information necessary to dispel any questions he or she may have. Furthermore, many of these citations are not traceable without the aid of technologically advanced library systems with computerized data bases, which are usually present only in university libraries not accessible to the general public. Because of these limitations, most people will read or hear health information only through the media and are, therefore, extremely dependent on the accuracy of reported health research in the popular press for information related to their health and well-being.

Recommendations

Although recommendations for improving accuracy in health reporting and interactions between media and medical scientists have been dealt with quite extensively elsewhere (see Burkett, 1986; Engel, 1990; N. E. Miller, 1986), we offer some suggestions based on our investigation.
The first deals with the absence of citations to specific studies in the popular media. Although print media are often pressed for space, and the journalist does not have control over final editing cuts, enough detail should be provided for the reader to be able to locate more information. It takes little space to list the principal investigator's name, the journal title, and a date of publication.

Second, eliminating erroneous information is of primary importance. Although journalists carry a great deal of the responsibility for checking facts before they are in print, it was found in one study that only 14% of science writers routinely call a cited researcher to do so (Tankard & Ryan, 1974). Thus, increasing this kind of follow-up, especially if a journalist is unfamiliar with the subject matter, is strongly recommended. However, scientists need to do as much as possible to see that their research is accurately represented (see N. E. Miller, 1986, for detailed suggestions on how scientists should present research to the media).

Finally, and related to the previous point, many of the errors may be attributable to problems with information obtained by personal communications and interviews (McCall, 1988). One difficulty is that this information cannot be verified by the reader. Often the journalist states facts in such a way that what could have come only from an interview is attributed to the original research report. According to McCall (1988), this is as much the fault of the scientists as the journalists. Scientists may well be trained in how to present information in an interview, using well-prepared notes, limiting the topic, and avoiding terms that are too technical (Cameron, 1991). Journalists, on the other hand, need to exercise caution in the interview process, verifying the information provided and attributing facts to their proper sources. Both scientists and journalists have roles to play improving accuracy in health reporting.

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