# • SPECIAL ARTICLE •

# Guiding Questions for Appraising Epidemiologic Literature

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**Objective: Scientific findings need to be summarized for the better understanding of the community and for the development of the respective preventive actions that they espouse, suggest, or imply. The news media play a critical role in communicating health information to the public. Among chronic diseases, cancer receives a great deal of attention from the media, possibly because of its position as a leading cause of death. While the news media are vital to the dissemination of health information, one of the main information sources comes from epidemiological studies. Thus, it is important that health professionals interpret the results of these studies in order to efficiently communicate the results in a thorough and comprehensible manner. This special article aims to guide health professionals through the process of reading and interpreting the most relevant components of epidemiological literature.**

**Methods: Guiding questions were prepared based on the main components of the aforementioned literature.**

**Results: An abstract that was chosen from the available literature was used for the responses to the proposed guiding questions.**

**Conclusion: We expect that reading the proposed questions will improve the communication and dissemination of epidemiological findings, thereby contributing to the understanding of the health problems of our community. Also, we expect the readers to visit the recommended web sites presented at the end of this document for more complete definitions of the epidemiological terms found herein. [*P R Health Sci J 2014;33:39-44*]**

*Key words: Guiding questions, Epidemiology, Mass media*

One of the main functions in Public Health is to promote preventive programs in order to improve the health of the community (1). The role of the mass media in Public Health is vital to accomplish this function (2). Among chronic diseases, cancer receives great attention from the media, possibly because of its position as a leading cause of death. However, it is unknown if reports from the media reflect the limitations involved in data collection methods or just the positive view of a particular finding (3). While the news media are vital to the dissemination of health information, one of the main sources of information comes from epidemiological studies. The aim of these publications is to provide their readers—whether experts in the field or less scientifically sophisticated individuals—with usable information that is written in clear, unambiguous language (4). The empirical findings of these epidemiological studies are expected to be used for different purposes, but mainly to promote preventive measures for specific diseases in communities with particular needs or to set ground for future analytical studies. Thus, it is important that health professionals correctly interpret those results of these studies in order to efficiently communicate the results in a thorough and comprehensible manner. The systematic appraisal of epidemiological literature must include a methodological assessment of the data processing and the potential clinical application of a given study's results (5).

*Epidemiology* is the study of the occurrence and distribution of health-related events in specified populations and the application of this knowledge to the control of health problems (6). The major types of study designs used in the field of epidemiology are often classified as descriptive or analytical studies, the definitions of which are as follows:

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- *Descriptive epidemiology* focuses on describing the occurrence (incidence, prevalence, and mortality) and distribution of disease (or another health event) patterns by characteristics relating to person (who is affected by the health event?), time (when does the health event occur?), and place (where does the health event occur?). Descriptive studies often use routine data (i.e., vital statistics, surveillance systems, or registries) collected in a population to characterize the patterns of disease occurrence (7). The data generated from descriptive studies can be used for healthcare planning and hypothesis generation. Types of descriptive studies include case-series, cross-sectional, and ecological studies.
- *Analytical epidemiology* is concerned with assessing the associations between exposures and disease (or another health outcome), which associations may provide further insights into the causes of a disease and lead to prevention strategies. Basic types of analytical studies include case-control studies, cohort studies, and clinical trials.

There are several key elements that have to be assessed if one is to interpret and communicate the findings of a research study properly. Among these elements are the research question, research hypothesis, study aims, study design, main study outcome, predictive variables, statistical methods, and interpretation of results. These key elements are presented in different forms, depending on the information source being used (7). When the epidemiological results are presented in a scientific manuscript, these key elements are usually inserted in 1 of the following 4 basic sections of a manuscript: Introduction, Materials and Methods, Results, and Discussion. Therefore, this special article aims to guide persons through the process of reading an epidemiological article, interpreting the results, and reporting them to the general population.

Two tables were prepared in order to help the reader summarize a scientific study. Table 1 describes the main sections of a scientific article: Authors, Abstract, Introduction, Materials and Methods, Results, and Discussion. Guiding questions along with key elements and basic definitions were presented for each of the main sections. Each guiding question targets a specific aspect that must be assessed in order to thoroughly understand an epidemiological study. Thus, Table 1 will help public health professionals to summarize epidemiological research by guiding them through the basic structure of a scientific publication. In each section, the reader can provide responses for all or some of the guiding questions depending on the source of information being used. Table 2 was prepared as an exercise to answer several of the guiding questions presented in Table 1, using an abstract of a scientific article as the source of information.

## Possible sources of information

When researchers complete a research study, they may decide to communicate their study results through different channels. It is important to recall that not all of these channels provide the same information; therefore, it is possible that all of the guiding questions presented in Table 1 can be answered, depending on the source of information. For example, an abstract of a scientific article can be very informative but still lack significant information. Therefore, it is recommended that you read the complete scientific article to better understand the rationale of the study, the methodology, its limitations, and the results. The following are possible sources of information for obtaining the results of a specific cancer study:

- Personal communication with the investigator (s)
- Abstract of a scientific article published in a journal or available on the Internet
- Scientific article published in a journal or on the Internet Example:

In order to show the application of the proposed guiding questions, we offer the following abstract (printed verbatim) of a published scientific article entitled Smoking and Lung Cancer Risk in American and Japanese Men: An International Case-Control Study (8):

Abstract: Rates of lung cancer in American men have greatly exceeded those in Japanese men for several decades despite the higher smoking prevalence in Japanese men. It is not known whether the relative risk of lung cancer associated with cigarette smoking is lower in Japanese men than American men and whether these risks vary by the amount and duration of smoking. To estimate smoking-specific odds ratio for lung cancer in men, a multicentric case-control study was carried out in New York City, Washington, DC, and Nagoya, Japan from 1992 to 1998. A total of 371 cases and 373 age-matched controls were interviewed in United States hospitals and 410 cases and 252 hospital controls in Japanese hospitals; 411 Japanese age-matched healthy controls were also randomly selected from electoral rolls. The odds ratio (OR) for lung cancer in current United States smokers relative to nonsmokers was 40.4 [95% confidence interval (CI) = 21.8–79.6], which was >10 times higher than the OR of 3.5 for current smokers in Japanese relative to hospital controls (95% CI = 1.6–7.5) and six times higher than in Japanese relative to community controls (OR = 6.3; 95% CI = 3.7–10.9). There were no substantial differences in the mean number of years of smoking or average daily number of cigarettes smoked between United States and Japanese cases or between United States and Japanese controls, but American cases began smoking on average 2.5 years earlier than Japanese cases. The risk of lung cancer associated with cigarette smoking was substantially higher in United States than in Japanese males, consistent with population-based statistics on smoking prevalence and lung cancer incidence. Possible explanations for this difference in risk include a more toxic cigarette formulation of American manufactured cigarettes as evidenced by higher concentrations of tobacco-specific nitrosamines in both

tobacco and mainstream smoke, the much wider use of activated charcoal in the filters of Japanese than in American cigarettes, as well as documented differences in genetic susceptibility and lifestyle factors other than smoking.

## Discussion and Conclusions

The purpose of the responses to the guiding questions is to provide the most adequate and clear information to health professionals to efficiently communicate the results in a thorough and comprehensible manner. The ability to critically evaluate and summarize the results of published scientific literature is one of the skills that health professionals should possess, thereby enabling them to effectively disseminate the information generated in scientific literature to the general public, specifically that related to chronic diseases such as cardiovascular disease, diabetes, and cancer, because of both their magnitude and the impact of their early detection.

When reporting epidemiological studies, it is recommended to avoid "definitive" statements, such as "The results undeniably demonstrate that…" In general, caution is called for when interpreting the results of observational studies. In addition, as is the case in all-scientific communication, it is important to summarize the main epidemiological finding as concisely as possible to improve readability when reporting on epidemiologic studies; slang and abbreviations should be avoided or used

carefully and then only when they have achieved universal acceptance (e.g., DNA, AIDS, CHD, and HPV). The over-use of abbreviations, while allowing the lengthy interpretation of results to be shortened, tends to decrease a paper's readability, particularly for readers not entirely familiar with the research topic (5).

We are aware that the critical appraisal of scientific literature is a complex process that requires time and effective communication with professionals in the fields of medicine, epidemiology, and biostatistics. The more effective the communication with these professionals, the better the dissemination of information will be. Moreover, the more trustworthy are one's sources of information, the better will be one's understanding of a specific research study. Those persons interested in publishing epidemiological findings should identify 1) the technical resources in their communities, 2) the main health problems that are affecting those communities, and 3) reliable sources of information of epidemiological studies that are generating scientific knowledge on those health problems of interest. For a detailed definition of additional terms in epidemiology, you can visit the following websites: http://www.cancer.gov/dictionary, http://www.cdc.gov/excite/library/glossary.htm

Finally, warranted studies are recommended to explore and validate the most effective means to communicate and disseminate the epidemiological findings in certain populations with specific needs and specific diseases, such as impaired, elderly, or blind community.

**Table 1**. Guiding questions for reading and interpreting epidemiologic literature

| Section of an article | Key element | General definition | Guiding question |
|---|---|---|---|
| *Authors* | Names of the authors and the institutions they represent | A list of investigators who may have participated in any of the following: 1) the design of the study, 2) data collection, 3) data analysis, 4) results interpretation, 5) and/or the preparation or editing of the manuscript. In this list we can also identify the institution with which they are affiliated. | -Who are the authors of this article?<br>-With what institution or institutions are the investigators affiliated? |
| *Abstract* | The main goals, methods, main findings, and conclusions of the study. | The abstract is a summary of the research article. It includes a brief explanation of the following sections: 1) introduction and main goal(s), 2) method(s) for data collection and data analysis, 3) main results, including the main statistical findings, 4) and conclusion(s). | -What main problem does the article address?<br>-What is the main goal of the study?<br>-What procedures were performed to obtain the data?<br>-What were the main findings of the project?<br>-What are the implications of the findings? |
| *Introduction* | Background | This section describes the theoretical framework, presents a review of the scientific literature (including current knowledge of the topic studied and existing knowledge gaps), provides information that justifies the need, and describes the purpose of the study. An extensive review of the scientific literature is required to summarize previous research and identify the gaps in knowledge that the research study in question intends to fill. | -What is the main problem?<br>-What are the current knowledge gaps?<br>-What is the impact of the problem, both locally and internationally? |
| | Research question | Clear statement of the research question to be answered. It must be measurable, precise, and specific. | -What is the justification for this study?<br>-What is the research question?<br>-What is the justification for this study?<br>-What are the general and specific objectives? Does this study fill a gap in current scientific knowledge? |

| Section of an article | Key element | General definition | Guiding question |
|---|---|---|---|
| *Introduction* | Research hypothesis | Based on the findings of the literature review, the investigators formulate a research hypothesis based on the purpose of the study. The research hypothesis is a supposition or reflection that leads to predictions that can be tested and, thereby, either confirmed to be accurate or found to be faulty (6). | -Is the hypothesis consistent with the research question? -Does the hypothesis propose a possible explanation for the problem under study? -What will the impact of this study be if the research hypothesis is supported by the new information? |
| *Materials and Methods* | Research design | The "architecture" of a study: a description of the study design, target population, sample selection, health outcome and exposures of interest, methods of data collection, data processing, and statistical analysis (9). In analytical epidemiology, two basic study designs are used: the case-control study design and the cohort study (longitudinal) design. Case-control studies initially select cases (diseased subjects) and controls (healthy subjects) and then compare prevalence of exposure. Cohort studies first identify exposed and non-exposed subjects free of disease and then compare the incidence of disease. In descriptive epidemiology, the most common design is that of the cross-sectional study, which involves the simultaneous collection of the data related to the exposure and the health event in a certain population, at a specific point in time. | -What is the population under study? -What is the study design? -What are the study groups? Are they comparable? -What is the method for subject selection? Is it adequate for the evaluation of the research question? -What are the advantages and disadvantages of the method used to select subjects? -What are the inclusion and exclusion criteria for the subjects? -What is the sample size? -What is the time frame of the proposed study? -What are the statistical methods that will be used to assess the study aims? Are these adequate? -What institutional ethics committee approved this project? |
| | Main health outcome or response variable | Usually in epidemiology, this variable is the health event under investigation (incidence or prevalence of symptoms, lifestyle, disease, or death). In addition, it can be defined as being the main characteristic in the study group that is measured and studied to evaluate which factors have an effect on its statistical distribution. | -What is the main outcome under study? -How was the outcome measured? -What was the measurement scale used for this variable? -Is the assessment of the outcome accurate? -What factors are considered to have an effect on the main outcome? |
| | Independent or predictive variables | These are the variables or factors to be considered as potential predictors of the main outcome. In epidemiological studies, these variables are new exposures, risk factors, and other control variables. | -What are the predictive variables (or risk factors) of interest? -How were these variables measured? -What was the measurement scale used for these variables? -Is the assessment of these variables accurate? |
| | Confounding variables (confounders) | In analytical epidemiology, the confounders are variables that are risk factors for the disease under study and that are associated with the exposures and the outcomes of interest (6). These variables need to be taken into account to estimate the strength of association between the exposure and the main outcome. | -What are the potential confounders for the variables of interest? -Why were these potential confounders considered? -How were these variables measured? -What are the methods used to control for the confounding variables? -What is the effect of the confounders on the association of interest (disease and exposure)? |
| | Statistical analysis methods | Quantitative methods are used to assess a study's aims. There are two general methods: descriptive and inferential. The former includes summary statistics that describe the study group (i.e., mean, standard deviation, proportion, percentiles, proportion and range) and other measures, such as Relative Risk (RR) and Odds Ratio (OR), which are used to quantify the magnitude of association between the outcome and the main exposures. On the other hand, inferential statistics (estimation and hypothesis testing) are concerned with making inferences or predictions about a given study population based on the data collected from the study sample. | -What are the statistical hypotheses? -What is the sample design? -Are the statistical analyses adequate? -Does the study have sufficient statistical power to effectively evaluate the research question? -How was the magnitude of the association between the disease or outcome and the main predictor measured? |
| | Bias | Any systematic error in the design or conduct of the study that affects the validity of the findings. For example, there might be a) problems when providing precise information regarding a disease that occurred more than a year ago, b) problems with selecting the subjects under study (usually healthy people are more willing to participate), and c) problems when measuring the disease of interest if the instruments are not calibrated equally (6). | -What possible biases could have been created during the design and conduct of the study? -What methods are used to assess potential bias? -How do the possible biases affect the validity of the results? |

| Section of an article | Key element | General definition | Guiding question |
|---|---|---|---|
| *Results* | Interpretation of results | An objective and critical process of analysis of the results achieved through the statistical evidence generated in the study. | -What were the main findings of the study?<br>-What is the evidence in favor of or against the research hypothesis?<br>-What is the magnitude of the observed effect?<br>-Was the selected sample size sufficient to test the research hypotheses?<br>-Are the results consistent with previous studies?<br>-Can the results be generalized? |
| *Discussion and Conclusions* | Discussion of study findings and subsequent conclusions | The discussion is an interpretation of the study findings and whether they support the research hypothesis. This section explains how the findings compare with what is already known about the subject under study. The conclusion explains how the new findings in the study can be used for future studies in the area. | -Are the findings supported by previous research?<br>-Do the findings have a biological explanation?<br>-If the research hypothesis was not supported, can the findings be explained by the sample size or sources of bias?<br>-Can the findings of the study be generalized to other populations?<br>-What will the impact of this study be in terms of the new information generated?<br>-What are the implications of the study findings in terms of clinical practice? |

**Table 2**. Possible answers to the Proposed Guiding Questions based on the abstract

| Guiding question | Possible answer |
|---|---|
| -Who are the investigators? | Among the study's investigators are epidemiologists from both the United States of America (USA) and Japan: Steven D. Stellman, Toshiro Takezaki, Lisa Wang, Yu Chen, Marc L. Citron, Mirjana V. Djordjevic, Susan Harlap, Joshua E. Muscat, Alfred I. Neugut, Ernst L. Wynder, Hiroshi Ogawa, Kazuo Tajima, and Kunio Aoki. |
| -Who is funding this project? | The project was supported by US Public Health Service Grants CA-68384, CA-32617, and CA-17613 from the National Cancer Institute and by a grant from the Verum Foundation. |
| -What is the main problem? | Rates of lung cancer in American men have greatly exceeded those in Japanese men for several decades, despite the higher smoking prevalence in Japanese men. |
| -What is the general objective? | To estimate smoking-specific relative risks for lung cancer in men. |
| -What is the study hypothesis? | The risk of lung cancer in American men is higher than Japanese men, despite higher smoking prevalence in Japanese men. |
| -What is the study design? | A multicentric age-matched case-control study was carried out in New York City, Washington, DC, and Nagoya, Japan from 1992 to 1998. |
| -What is the main outcome of interest, and how will it be measured? | The main outcome of interest is lung cancer. The abstract does not provide information regarding how lung cancer was measured. |
| -What are the predictive variables (or risk factors) of interest? How were these variables measured? | The main predictive variable is the smoking habit among the study population. (The abstract does not give us enough information about how this variable was measured). |
| -What is the method for subject selection? | In the United States, cases and controls were selected from hospitals. In Japan, cases were selected from hospitals and controls were selected from hospitals and electoral rolls. A total of 371 cases and 373 age-matched controls were interviewed in United States hospitals and 410 cases and 252 hospital controls in Japanese hospitals; 411 Japanese age-matched healthy controls were also randomly selected from electoral rolls. |
| -What are the statistical methods that will be used to assess the study aims? | The abstract mentions the use of the odds ratio (OR) to assess the magnitude of the association between lung cancer and current smokers, but it does not describe the statistical procedure to estimate this measurement of association, neither the potentials confounders. |
| -What are the main findings of the study? | The OR for lung cancer in current United States smokers relative to nonsmokers was 40.4, which was 10 times higher than the OR for current smokers in Japanese relative to hospital controls and six times higher in Japanese relative to community controls. |
| -Are the results consistent with those of previous studies? | The results are consistent with population-based studies on smoking prevalence and lung cancer incidence. However, the OR's in the United States were computed using the nonsmokers as reference group; while in Japan, the reference group came from hospital controls and community controls. |

## Resumen

Antecedentes: Los resultados científicos necesitan ser resumidos para una mejor comprensión en la comunidad y por consiguiente, de las acciones preventivas correspondientes. Los medios de comunicación juegan un papel sumamente importante en transmitir información sobre la salud para el público general. Específicamente, el cáncer recibe una mayor atención de los medios debido a su posición como una de las principales causas de muerte. Dado que los medios de comunicación son vitales en difundir la información de salud, una de sus fuentes principales de información proviene de estudios epidemiológicos. Por consiguiente, es importante que los profesionales de la salud interpreten estos estudios para poder comunicar los resultados de manera clara, eficiente y detallada. Objetivos: Este documento tiene como objetivo principal guiar a los profesionales de la salud a través del proceso de leer e interpretar los componentes más relevantes de la literatura epidemiológica. Métodos: Preguntas guías fueron preparadas de acuerdo con los componentes principales de la literatura epidemiológica. Resultados: Un resumen de esta literatura se utilizó para ejemplificar las respuestas a diferentes preguntas-guías. Conclusiones: Esperamos que la lectura de las preguntas propuestas mejorará la comunicación y difusión de los hallazgos epidemiológicos de contribuir al entendimiento de los problemas de salud de nuestra comunidad. Además, esperamos que los lectores pueden visitar las páginas cibernéticas recomendadas que se presentan al final de este documento para obtener una definición más extensa de los términos epidemiológicos.

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