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Workshop Report: Physical Activity and Cancer Prevention

Loraine D Marrett, Beth Theis, Fredrick D Ashbury and an Expert Panel

Abstract

A workshop to evaluate the evidence for the role of physical activity in cancer prevention and to identify priorities for action, particularly in relation to the primary prevention of cancer, was held by Cancer Care Ontario in March 2000. A review of the scientific evidence was commissioned and an expert panel convened to consider the review report and to make recommendations for public health, research and intervention. The panel concluded that evidence was convincing for the role of physical activity in preventing colon cancer; probable for breast cancer; possible for prostate cancer and insufficient for other sites. It recommended that physical activity messages promoting at least 30–45 minutes of moderate to vigorous activity on most days of the week be included in primary prevention interventions for cancer. The panel recommended that future research on physical activity incorporate comprehensive assessments, including measures of the multiple dimensions and types of physical activity; biological mechanisms; and behavioural and population factors. Cancer Care Ontario will incorporate physical activity messages in its primary prevention programming around nutrition and healthy body weight.

***Key words**: cancer etiology, cancer prevention, physical activity*

Introduction

Cancer is the second ranking cause of death in Ontario after cardiovascular diseases. Unless cancer mortality rates decline as significantly as have those for cardiovascular diseases, it will likely become the leading cause of death within a few decades.[1]

The National Cancer Institute of Canada estimates that 24,700 women and 25,200 men will be diagnosed with cancer and 11,200 women and 12,500 men will die from cancer in Ontario in the year 2000.[2] As the population grows and ages, and as techniques to detect cancer in its early stages are more systematically applied and improved, the number of people diagnosed with cancer will continue to rise. Health Canada's Cancer Bureau estimates that, if current trends continue, the number of new cancer cases will increase by 40% by the year 2010.[3]

The escalating cancer burden will increase the need for treatment services and will have serious repercussions for Ontario's health care system. A report by the Chief Medical Officer of Health for the Province of Ontario stated that some $1 billion was spent to treat persons with cancer in 1994 alone.[4] Current costs are certainly higher because of the greater number of cases, and because the costs of some new chemotherapeutic agents are higher than those previously used. A diagnosis of cancer has serious personal financial consequences in the form of lost wages and the cost of medications to offset the symptoms of the disease and its treatments.

Cancer control encompasses prevention, early detection, treatment, supportive care, research and education. Although there have been impressive advances in the treatment of a few cancers, the four most common cancers (i.e., lung, breast, colon and prostate) have to date proved extremely difficult to treat effectively.[5] To achieve important reductions in cancer incidence, morbidity and mortality, greater emphasis should be placed on prevention.[6] Effective prevention initiatives can decrease cancer incidence and mortality by 50% or more.[7]

Rates of cancers of the colon, breast and prostate vary considerably around the world.[8] For example, they are all much more common in North America than in Asia. These patterns and a large body of research support an

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TABLE 1
Description of levels of evidence[a]

Level of evidence	Description
Convincing	Epidemiological studies show consistent associations, with little or no evidence to the contrary. There should be a substantial number of acceptable studies (more than 20), preferably including prospective designs, conducted in different population groups and controlled for possible confounding factors. Exposure data should refer to the time preceding the occurrence of cancer. Dose-response relationships should be supportive of a causal relationship. Associations should be biologically plausible. Laboratory evidence is usually supportive.
Probable	Epidemiological studies showing associations are either not so consistent, with a number of studies not supporting the association, or the number or type of studies is not extensive enough to make a more definite judgment. Mechanistic and laboratory evidence is usually supportive.
Possible	Epidemiological studies are generally supportive, but are limited in quantity, quality or consistency. There may or may not be supportive mechanistic or laboratory evidence. Alternatively, there are few or no epidemiological data, but strongly supportive evidence from other disciplines.
Insufficient	There are only a few studies, which are generally consistent, but really do no more than hint at a possible relationship. Often, more well-designed research is needed.

[a] Descriptions are from the World Cancer Research Fund/American Institute for Cancer Research.[10]

important role for lifestyle factors in the etiology of these, as well as many other, types of cancer.

Identifying the role of physical activity in cancer prevention

In the fall of 1999, the Division of Preventive Oncology at Cancer Care Ontario (CCO) initiated a two-step process to identify opportunities for research, policies and programs relating to physical activity and the primary prevention of cancer:

1. an expert in physical activity and cancer was commissioned to review, evaluate and summarize the evidence; and
2. a workshop of experts was convened to consider the review and to develop a consensus on the level of evidence and priorities for action.

CCO is a provincial cancer control agency responsible for the provision of many key cancer services and for overseeing all aspects of cancer control in Ontario. CCO's Division of Preventive Oncology is responsible for cancer prevention, screening and surveillance, research in preventive oncology and the Aboriginal cancer care program.

Review of the evidence for physical activity and cancer prevention

As a first step, CCO engaged Dr. Christine Friedenreich of the Alberta Cancer Board to conduct a systematic review of the published literature on the etiologic role of physical activity in relation to cancer.[9] Dr. Friedenreich is a recognized expert in this field and is also familiar with the operational context of provincial cancer agencies. Her review included an assessment of the frequency, intensity and duration of physical activity associated with cancer risk reduction, a summary of physical activity intervention research, and her recommendations for further research and public health actions.

Dr. Friedenreich evaluated the evidence relating physical activity to a variety of cancers using an adaptation of the criteria described in the report by the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) on nutrition and cancer prevention.[10] In this report, "convincing" evidence was defined as evidence that is conclusive; "probable" means that the evidence is strong enough to conclude that a causal relation was *likely*; "possible" means that a causal relation *may* exist; and "insufficient" means evidence is suggestive but too sparse to make a more definitive judgement. Table 1 presents more detailed descriptions of these levels of evidence.[10]

Dr. Friedenreich's report formed the basis of the workshop discussions. It was, however, expected that the participating experts' own knowledge of, and perspective on, both published and ongoing research would amplify and perhaps alter Dr. Friedenreich's conclusions and recommendations.

The workshop

The Physical Activity and Cancer Prevention workshop was held in Toronto on March 24–25, 2000. An expert panel was convened, comprising 11 scientists from academia, government and cancer agencies in Canada, the United States and Norway. Seven others were invited to attend as observers. See Appendix 1 for a list of participants, who represented the disciplines of epidemiology, physical education and health, exercise science and behavioural science.

Goal and objectives

The workshop's goal was to evaluate the evidence for the role of physical activity in preventing cancer. Its objectives were to achieve consensus on:

- whether the epidemiological, biologic and intervention evidence on physical activity and cancer prevention is sufficiently strong to provide clear

TABLE 2
Summary of epidemiologic evidence on the association between physical activity and cancer[a]

Cancer site	Consistency of evidence for a risk reduction with increased physical activity levels[b]	Strength of risk association	Dose-response[c]	Time of life	Biologic plausibility	Overall level of scientific evidence[d]
Colon	42 of 48	up to 70% ↓	21 of 31	Activity throughout life?	Yes – several possible mechanisms	Convincing
Breast	22 of 33	up to 70% ↓ to no effect	13 of 21	Early life? Adult life?	Yes – several possible mechanisms	Probable
Prostate	14 of 23	up to 50% ↓ to a 220% ↑	9 of 17	Early life?	Yes – some possible mechanisms	Possible
Lung	7 of 10	60% ↓ to 30% ↑	5 of 7	Unknown	Unclear	Insufficient
Testis	2 of 5	50% ↓ to no effect	2 of 4	Unknown	Unclear	Insufficient
Ovary	1 of 4	No effect	1 of 2	Unknown	Yes – a few possible mechanisms	Insufficient
Endometrium	7 of 11	90% ↓ to no effect	3 of 6	Unknown	Yes – a few possible mechanisms	Insufficient

[a] Adapted from (9) and (13).
[b] Number of consistent studies out of total studies, both case-control and cohort.
[c] Number of studies with dose-response out of total studies.
[d] See Table 1 for definitions.

direction for public health recommendations and/or population interventions;

- recommendations for further action (knowledge gaps to be addressed by research, types of research needed, public health recommendations, and/or interventions) according to cancer site (colorectal, breast, prostate, other sites); and
- priority areas for further action.

Workshop materials, structure and agenda

Before the event, participants were sent the workshop agenda, a list of attendees, a copy of the report prepared by Dr. Friedenreich[9] and published papers by two of the workshop participants in the specific areas of biologic mechanisms[11] and intervention research[12]. During the workshop itself, selected additional information was distributed (e.g. Canadian data on population levels of physical activity; a summary of public health recommendations on physical activity from a variety of organizations).

A questionnaire intended to identify the workshop participants' perceptions of the state of the evidence (epidemiologic, biologic and intervention research) and to help identify public health issues and recommendations was also included in their pre-workshop packages. Participants were asked to submit their completed questionnaires to the facilitator before the event so that the responses could be collated for presentation early in the workshop. A copy of the pre-workshop questionnaire is appended to this report (Appendix 2).

The workshop agenda called for a full day to review, discuss, and begin to develop a consensus on the evidence. The second, shorter day was reserved for completing the development of the consensus and for developing public health recommendations supported by that evidence.

Discussion of the evidence

Workshop participants were given an orientation to the needs of CCO's Division of Preventive Oncology in the development of strategies on physical activity and cancer prevention. This was followed by the presentation of Dr. Friedenreich's report and of the pre-workshop questionnaire results. Table 2 summarizes Dr. Friedenreich's review of the epidemiologic literature and her evaluation of the strength of the evidence.

The presentations stimulated discussion on the quality of the epidemiologic evidence for various cancer sites and the potential for developing public health recommendations. This led to more focused discussion on possible biologic mechanisms for physical activity and cancer prevention and exercise intervention research.

Workshop findings

Consensus on the evidence

The workshop participants largely endorsed the conclusions of relationships between physical activity and cancer prevention presented in Dr. Friedenreich's review. The consensus on levels of evidence is outlined in Table 3.

TABLE 3
Consensus level of evidence for physical activity and cancer prevention

Cancer site	Level of evidence[a]
Colon[b]	Convincing
Breast	Probable
Prostate	Possible
Endometrium, lung, testis	Insufficient but promising for further investigation
Other	Insufficient

[a] See Table 1 for descriptions
[b] Many studies considered only colon and rectum cancers combined. However, there were enough studies on colon cancer alone to conclude that the evidence related to it, but not to rectal cancer, was convincing.

TABLE 4
Consensus public health recommendations on physical activity and cancer risk reduction

- Physical activity recommendations should be included in primary prevention interventions for cancer prevention.
- All messages for physical activity should be in the context of ***reducing the risk of cancer rather than preventing cancer***.
- In order to get cancer risk reduction benefits, ***physical activity should comprise at least 30–45 minutes of moderate to vigorous activity on most days of the week***.
- Examples of moderate and vigorous physical activities should be provided as part of messaging; these should include activities appropriate to various age, sex and cultural groups.
- Messaging should recognize the variation in maximal cardiorespiratory capacity within the population. For example, since maximal capacity declines, on average, with increasing age, the upper end of the recommended activity level (i.e. 45 minutes of vigorous exercise) is in general more appropriate for youth and the lower end (i.e. 30 minutes of moderate exercise) for the elderly. Recommended activity levels for those who have been sedentary should initially be less than for those who are already active.
- Physical activity messages can be linked to other risk reduction messages, such as maintaining a healthy body weight.
- Physical activity should be encouraged at all ages.
- Advocacy is required for policies and environmental supports for physical activity.
- A surveillance and measurement system should be implemented for tracking population levels of physical activity.

Public health recommendations

Table 4 presents the consensus public health recommendations for cancer risk reduction made to CCO by the workshop participants. The participants acknowledged the challenges of drawing definitive conclusions for public health recommendations from the available evidence; the scientific literature does not provide information on the details of level of physical activity required to achieve optimal benefit (i.e. duration, frequency, intensity, age). Despite these caveats, participants felt there was sufficient evidence to make responsible recommendations that were not inconsistent with those of other health bodies. Some examples are displayed in Table 5.

TABLE 5
Summary of recommendations on physical activity from various organizations

Source	Recommendation[a]
Health Canada/ Canadian Society for Exercise Physiology (Canada's Physical Activity Guide)[14]	Get active your way, every day – for life. Scientists say accumulate 60 minutes of physical activity every day to stay healthy or improve your health. As you progress to moderate activities you can cut down to 30 minutes, 4 days a week. Add up your activities in periods of at least 10 minutes each. Start slowly … and build up.
Canadian Cancer Society (Seven Steps to Health)[15]	Be physically active on a regular basis. This will also help you maintain a healthy body weight.
Harvard Center for Cancer Prevention (7 ways to prevent cancer)[16]	Get at least 30 minutes of physical activity every day.
American Cancer Society (Guidelines on diet, nutrition and cancer prevention)[17]	Be at least moderately active for 30 minutes or more on most days of the week.
U.S. Dept of Health and Human Services (Healthy People 2000)[18]	*Objective:* Increase the proportion of people aged 6 and older who engage regularly, preferably daily, in light to moderate physical activity for at least 30 minutes per day to at least 30 percent.
U.S. Dept of Health and Human Services (Healthy People 2010)[19]	*Objectives:* Increase the proportion of adolescents who engage in vigorous physical activity that promotes cardiorespiratory fitness 3 or more days per week for 20 or more minutes per occasion. Increase the proportion of adults who engage regularly, preferably daily, in moderate physical activity for at least 30 minutes per day.
International Union Against Cancer (UICC) (Statement on diet, nutrition and cancer)[20]	Exercise to maintain weight.
World Cancer Research Fund/American Institute for Cancer Research[10]	If occupational activity is low or moderate, take an hour's brisk walk or similar exercise daily, and also exercise vigorously for a total of at least one hour a week.

[a] Quoted directly from the referenced documents.

Research recommendations

Participants felt that more research was needed for the effects of physical activity on many cancer sites. All but one of the recommendations presented in Table 6 apply to studies of any cancer site. Because the evidence for the benefit of physical activity in colon cancer prevention is considered to be "convincing," participants identified the need to conduct intervention research of

TABLE 6
Summary of research recommendations on physical activity and cancer prevention

• **Physical activity assessment should be comprehensive and include measures of** ▪ type, frequency, duration and intensity of physical activity in the relevant exposure periods (e.g. lifetime) ▪ leisure, occupational, household and transportation forms of physical activity, in addition to other physical movements that require considerable energy expenditure (e.g. fidgeting) ▪ biologic mechanisms (relevant to individual cancer sites and across cancer sites) and ▪ behavioural and population (age, sex, socio-economic status, and culture) factors
• Research should incorporate an assessment of the way physical activity relates to other factors, including obesity, diet, genetics and exposures such as use of medications, smoking and alcohol.
• Studies should be conducted to establish biomarkers as intermediate endpoints in the pathway for the relationship between physical activity and cancer.
• Intervention research is needed for colon cancer to determine the efficacy and effectiveness of various strategies to reduce risk.
• Ongoing scans of published and current but unpublished physical activity research projects should be conducted to facilitate updating of assessment of evidence and public health recommendations.
• Research is needed into environmental supports and policies needed to facilitate physical activity intervention implementation and adherence.
• Qualitative research should be conducted to establish motivations to pursue a physically active lifestyle, with special attention to age, sex, socio-economic status, and culture.
• Methodological research is needed on recall bias and the use of self-administered vs. interview-based data collection protocols for physical activity assessment.

strategies to reduce colon cancer risk (see fifth-listed recommendation). The first recommendation is bolded to indicate that it represents a major overarching research consideration.

Discussion

As the number of women and men diagnosed with cancer in Ontario (and throughout Canada) continues to rise, epidemiologic, biologic, behavioural and intervention research studies will be needed to facilitate public health interventions for lifestyle factors that can be modified to reduce an individual's risk of developing cancer. The process followed in the workshop enabled a thorough discussion of the existing evidence and afforded participants an opportunity to discuss and identify recommendations and priorities for public health and further research.

CCO has already incorporated this evidence assessment summary into its "Blueprint for Cancer Prevention in Ontario," which was released in May 2000.[21] The Blueprint identifies tobacco control, promotion of healthy eating and physical activity as the organization's priorities for cancer prevention.

CCO is currently developing a program of risk reduction strategies based on nutrition, healthy body weight and physical activity. The recommendations from this workshop will be incorporated into a number of CCO's primary prevention initiatives. Risk factor surveillance activities are also being designed to track population trends in the recommended level of physical activity, particularly in relation to new strategies or programs.

The workshop recommendations should be widely disseminated. They will be useful to agencies and organizations concerned with physical activity and fitness, not necessarily in relation to cancer, to further justify their efforts to promote the health benefits of physical activity. They can also be used as part of the strategic justification for funding proposals, program development and policy advocacy efforts of CCO, its partners and other agencies.

Acknowledgements

This workshop was supported by funding from the Prevention Unit, Division of Preventive Oncology, Cancer Care Ontario. We extend our thanks to the 11 scientists who made up the expert panel, whose passion, graciousness and willingness to share in the development of recommendations will assist those working in cancer prevention for the province of Ontario. We would also like to thank the observers for their time, energy and insight and for providing a context for the ongoing implementation of these proceedings.

For further information on the workshop and its recommendations, please contact Dr. Loraine Marrett at Cancer Care Ontario.

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APPENDIX 1
Participants: Physical Activity and Cancer Prevention Workshop, Cancer Care Ontario, March 24–25, 2000

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APPENDIX 2
Pre-Workshop Questionnaire
Physical Activity and Cancer Prevention Toronto, March 24–25 2000

This survey has been developed to identify workshop participants' perceptions of the state of the evidence (epidemiologic, biologic, intervention research) on physical activity and cancer prevention, and to help identify issues and recommendations. We ask that you draw on your own area of expertise, experience and the materials in this package to complete the questionnaire for submission when you arrive at the workshop. We will summarize your responses and present them during the first morning. We will then return the questionnaire to you and ask that, as the discussion progresses during the day, you revisit your responses periodically.

State of knowledge *Please place ticks in the cells that reflect your opinion of the next steps for research or action for each cancer site.*

	Further research needed				Public health action warranted	
Cancer site	**Epidemiologic**	**Biologic mechanisms**	**Intervention research (efficacy)***	**Intervention research (effectiveness)***	**Public health recommendations**	**Population intervention programs**
Colorectal						
Breast						
Prostate						
Lung						
Testicular						
Ovarian						
Endometrial						
Other sites (please specify)						

* Efficacy research is the test of an intervention under ideal conditions (a randomized controlled trial); effectiveness research tests an intervention under routine conditions.

Overall strength of the evidence	**1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree** Please circle the number below that best represents your answer
The evidence on the association between physical activity and cancer prevention is sufficiently strong to provide clear direction for public health recommendations and/or interventions.	1 2 3 4 5

Comparing two different approaches to measuring drug use within the same survey

C Ineke Neutel and Wikke Walop

Abstract

Respondents to the National Population Health Survey in Canada (1996–97) were asked two types of questions about drug use that allowed a comparison of the responses. The first question was about self-reported drug use categories: "In the past month, did you take [e.g., antidepressants]?" The second asked about specific drugs: "What specific medications did you take over the last two days?" Responses to the latter were coded according to the main chemical entity and then grouped in specific drug product categories similar to the first question's self-reported categories. The two sets of drug use categories were cross-tabulated for the 62,588 respondents who were 20 years of age and older. The proportion of persons who reported taking specific drugs who had not previously answered "yes" to the question related to the corresponding self-reported drug use category ranged from a low of 4.8% for insulin/oral hypoglycemics to a high of 43.7% for narcotic analgesics. Various reasons for these discrepancies are discussed. A series of logistic regression models relating the discrepancies to respondent characteristics shows that there is no clear pattern of variables associated with the discrepancies. These results show that surveys should be carefully planned to reflect the type of information needed.

Key words: *drug classification; drug utilization; National Population Health Survey; pharmacoepidemiology; validation*

Introduction

There are different parameters and aspects to measuring drug use in a population, each with implications for survey results. For example, the source of data, whether it be pharmacy, physician or billing records, will affect the quality and content of the drug use data. Although pharmacy records provide detailed information on the drugs themselves, data on the consumer are very limited. The latter could be improved if a patient is allowed to purchase drugs at only one designated pharmacy, as is the case in some European countries. Even in this situation, information such as the indication for use or the extent to which patients actually consume the drugs will remain largely unknown. Data from general practitioner (GP) records could be more informative about the indication for drugs prescribed, and on diagnoses and other health-related data, but these records are not always consistently completed. Billing records are another potential source of data, with the major limitation that in all provinces but Saskatchewan these data are available only on individuals who receive welfare benefits or who are over 65. Health surveys, such as Statistics Canada's National Population Health Survey, provide information on drug use from consumers themselves, as well as being a source of data on many other health-related issues.

Home inventories are considered by some to be the best method of obtaining accurate and complete drug use data.[1,2,3] In this scenario, an interviewer visits the home of the respondent and lists all of the drugs in the medicine cabinet. Lau et al. compared home inventory data with pharmacy records (where patients have been assigned to a pharmacy) and found considerable agreement. However, drug use obtained from carefully constructed questionnaires can also be accurate. Klungel et al. reported that more than 90% of drugs reported after "directed recall" were recorded in pharmacy records.[4,5] Less accurate was the percentage of drugs that ought to have been used by the patient according to pharmacy records (71% concordance). Sjahid et al. found 80% concordant pairs on comparing pharmacy records with patient interviews.[6] In a military setting, self-report questionnaires showed a very high agreement (95%) with medical records. In another setting, medical records

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did not fare as well. For example, Heerdink et al. showed that GPs had recorded only 40% of drugs used by their patients, as learned in a home interview, while pharmacies had a record of 80%.[7] Few studies compared different ways of collecting information from the general population within the same study.

De Jong compared three types of questions in an interview on drug use in pregnancy with the drugs in pharmacy records and found that questions involving indication for drug use- and drug-specific questions were more accurate than open-ended questions.[8] The way the question on drug use is phrased is very important.

Collecting precise data during a survey on drug use is time-consuming and difficult. It is important to consider the way in which the drug use is recorded for the study, so that the data can be analyzed efficiently and accurately. Drugs can be recorded as specific chemical entities or specific drug products, e.g., lorazepam, fluoxetine, or can be grouped by chemical substance, e.g., benzodiazepines (BZD) or selective serotonin re-uptake inhibitors (SSRI). They can also be grouped by indication, e.g., cardiovascular drugs, which includes a variety of different types of drugs. The choice between these two methods is not always easy when planning a survey. Survey planners may be open to collecting actual drug names, but when they get to the final editing of the questionnaire and need to shorten the interview time, the larger drug categories may win.

Questions remain on the meaning of these categories. Can one assume that collecting the data as a drug category will give the same information as the grouping of specific drugs, e.g., to what extent will self-reported antidepressant use provide information on the use of tricyclics/SSRI, which are known to be the major antidepressant drug categories? The objective of this study is to determine the relation between self-reported drug use categories and the actual specific drug products that the respondents state they are taking.

Method

The National Population Health Survey (NPHS) is a large biannual Canadian health-related survey. The 1996–97 survey was conducted by telephone among residents in all provinces and territories, other than persons living on Indian reserves and Canadian Forces bases. Data collection took place in each of the four seasons and was carried out through a computer-assisted interviewing approach. Although the population included persons of 12 years of age and over, the present analysis will be limited to the responses of those 20 years of age and over. The NPHS 1996–97 survey used a statistical sampling design, making the study population representative of the Canadian population. However, for the present study statistical weighting will not be used since the major interest of the study is to compare answers to two sets of drug use questions by the same person, rather than drawing conclusions with respect to drug use in the Canadian population.

The first of the two sets of questions related to drug use over the past month: "Now, I would like to ask you a few questions about your use of medications, both prescription and over-the-counter as well as other health products. In the past month, did you take any of the following medications?" This was followed by a list of questions on 21 drug use categories. For the present study, three pairs of categories were combined:

1. Insulin and oral diabetic drug use were combined into one drug use category because it was suspected that there would be an overlap in users. Some results will be provided on the insulin and oral diabetic drug use separately.
2. Since antihypertensive drugs would also include diuretics, it was decided to combine the two questions on medicine for blood pressure, and diuretics or water pills, into one, for a better defined group.
3. The questions on tranquillizers and sedatives were combined since BZD are the most frequently prescribed drugs in both categories and the same drug could be given for either indication.

Respondents who answered "yes" to either one or both of these combined questions would be included in the relevant drug use category. Of the remaining questions, eight were omitted altogether, mainly because some questions, such as those on hormone replacement therapy and birth control, applied to women only, and questions concerning diet pills, allergy medication, cold medication, steroids, stomach pills and laxatives were more difficult to translate into specific drug use categories. Table 1 lists the 10 resulting categories that will be further explored and that will be called "self-reported drug categories" to signify that the respondents decided in which categories the drugs belonged.

The second set of questions was asked only of those respondents who had indicated drug use in the first set of questions. The question was worded as follows: "Now, I am referring to the past two days. During those two days, how many different medications did you take? What is the exact name of the medication to which you were referring?" The person was asked to look at the bottle, tube or box. The respondents were expected to collect all containers of drugs and related products and read the name of the drug or product from the label. The specific drugs or products were combined by the authors as much as possible into the 10 corresponding drug categories listed in Table 1. These are called "specific drug product" categories to stress that they are based on the exact drug product as distinguished from the "self-reported drug use" categories based on the first set of drug use category questions asked directly of the respondent.

The grouping of the specific drug products was made possible by coding the drugs using a Patented Medicine Prices Review Board (PMPRB) adaptation of the Anatomic Therapeutic Chemical (ATC) classification[9,10]

TABLE 1
Drug group definitions as derived from the self-reported drug category questions and the specific drug product questions

Drug groups	Self-reported drug categories based on the question: "In the past month did you take any of the following medications?"	Specific drug product question: "What medications did you take over the last two days?"	ATC Drug Codes*
Insulin, Oral diabetic drug	…insulin? …pills to control diabetes?	Insulin Oral hypoglycemic agents	ATC 'A10AA00' — 'A10AX99' ATC 'A10BA00' — 'A10BX99'
Thyroid	…thyroid medication such as Synthroid or Levothyroxine?	Thyroid medication	ATC 'H03AA00' — 'H03CA99'
Analgesics	…pain relievers such as aspirin or Tylenol (incl. arthritis med. and anti-inflammatories)?	NSAID, ASA, acetaminophen	ATC 'M01AA00' — 'M01XX99' ATC 'N02BA00' — 'N02BZ99'
Heart	…medicine for heart?	Heart: glycosides, antiarrhythmics, cardiac stimulants, vasodilators	ATC 'C01AA00' — 'C01ZZ99'
Asthma	…asthma medications such as inhalers or nebulizers?	Asthma, inhalers and nebulizers	ATC 'R03AA00' — 'R03CB01'
Antihypertensives	…medicine for blood pressure? …diuretics or water pills?	Antihypertensives, incl. diuretics	ATC 'C02AA00' — 'C08ZZ99'
Antibiotics	…penicillin or other antibiotics?	Tetracyclines, penicillins, cephalosporins, sulpha, macrolides, quinolones	ATC 'J01AA00' — 'J01XX00'
Tranquillizers, Sedatives	…tranquillizers such as Valium? …sleeping pills?	Benzodiazepines	ATC 'N05BA00' — 'N05BA99' ATC 'N05CD00' — 'N05CD99'
Antidepressants	…antidepressants?	Antidepressants: tricyclics, SSRI	ATC 'N06AA00' — 'N06AZ99'
Narcotic analgesics	…codeine, Demerol or morphine?	Codeine, demerol, morphine, methadone, darvon, acetaminophen/ASA with codeine	ATC 'N02AA00' — 'N02AH00'

* These are the modified ATC codes described in the text.

that was further adapted for survey purposes by one of the authors. The ATC system consists of a seven-digit alphanumeric code based on anatomical, therapeutic, and chemical substance subgroups. It is a hierarchical classification that divides the drugs into 14 main groups and four levels of subgroups. The PMPRB adaptation consists of changes in the last two digits of the original WHO version. Further changes made for the NPHS allowed for coding of all the main chemical substances (e.g., M01AB04 for diclofenac), as well as combination drugs, (e.g., M01AB64 for diclofenac and misoprostol), and more general categories, (e.g., M01XX99 for anti-inflammatory for arthritis). The coding itself was done largely by computer, e.g., Ativan (or lorazepam) was automatically assigned the code N28GC07. Frequently misspelled drug names, if there was no possibility of confusion with another drug, were also coded by computer. If the drug name was severely misspelled, or if there was any difficulty in interpreting which drug was meant, the decision on its identity was made by one of the authors.

The two sets of drug use questions had different time frames: while self-reported drug categories covered 30 days before the interview, the specific drug question covered two days before the interview. Theoretically, the drugs recorded as having been consumed in the last two days should also have been included in the last 30-day category. The assumption might be that if there is an answer in the specific drug use category, there should be an answer in the corresponding self-reported drug use category. Analysis of the data sought to determine to what extent the assumption is not true. The first part of the analysis consisted of cross-tabulating the two sets of drug use categories and determining what proportion did not overlap as one would have expected. Subsequently, logistic regression was used to examine whether other variables, such as age, sex, education, marital and health status, were predictive of which respondents were most likely to answer the drug use questions as expected. For each model, the population was restricted to those answering "yes" in the specific drug use category and the dependent variable was the self-reported drug use category. For example, in the case of antibiotics, the probability was modelled so that respondents did ***not*** answer affirmatively to self-reported antibiotic use in the last 30 days while reporting using specific antibiotics in the last two days.

Results

Table 2 shows the number of people who answered affirmatively to the drug questions that fit in the 10 categories provided. The categories were ranked according to the percentages in the last column, i.e., the percentage of the drug use in the specific drug use category that was not included in the corresponding self-reported drug use categories. Nine hundred and eighty-

TABLE 2
A comparison of number of respondents (ages 20 and over) reporting use in the self-reported drug categories with that of respondents reporting corresponding drugs in the specific drug product categories

Drug groups	Drug use in self-reported drug category	Drug use in specific drug product category	Drug use in the specific drug product category *only**	
			N	%
1. Insulin and oral diabetic drugs	1,949	1,159	55	4.8
Insulin	716	419	37	8.8
Oral diabetes drugs	1,378	756	50	6.6
2. Thyroid	2,935	1,996	114	5.7
3. Analgesics	42,360	5,909	406	6.9
4. Heart	3,518	1,050	107	10.2
5. Asthma	3,239	871	88	10.1
6. Antihypertensives	8,330	5,900	841	14.3
7. Antidepressants	2,637	1,546	269	17.4
8. Antibiotics	5,702	982	175	17.8
9. Tranquillizers/sedatives	3,649	931	248	26.6
10. Narcotic analgesics	3,672	1,031	450	43.7

* Drug use in the specific drug product category ***only***, i.e., the drug use recorded as part of the specific drug product use question without being reported as part of the self-reported drug use category.

two respondents listed antibiotics among the individual drugs that they had used in the past two days, but 17.8% of them had not answered "yes" to the question asking whether they had taken an antibiotic in the past month. Table 2 shows that the percentages of specific drug product use ***only*** (i.e., without answering the corresponding self-reported drug use category) ranged from a low of 4.8% for combined insulin and oral diabetic drug use to a high of 43.7% for narcotic analgesics. The percentage of specific drug product use only was also given separately for insulin and oral diabetic drug use and shows that each one has a higher individual percentage than the two combined.

Table 3 presents the distribution of a series of variables among the study population in preparation for the logistic regression analysis of Table 4. In total there were 62,588 respondents, of whom 46.1% were male and 53.9% female. Most respondents were in the youngest of the three 20-year age groups and the number decreased with age. Current marital status categories were defined as "having a partner," i.e., married or common-law, and "without a current partner," i.e., single, divorced or widowed. The large majority of the population "had a partner."

Table 4 shows logistic regression models with the population restricted to those who had listed drugs in the specific drug product category specified. The dependent variable is the self-reported drug use category. For example, the logistic regression model for antidepressant use was restricted to respondents reporting the use of specific antidepressants while the dependent variable referred to respondents answering "yes" or "no" to

TABLE 3
Respondent characteristics (ages 20 and over)

Variables (# missing)	Categories	No.	%
Total		62,588	100.0
Sex	Males	28,858	46.1
	Females	33,730	53.9
Age groups	20–39	26,034	41.6
	40–59	20,448	32.7
	60–80	13,502	21.6
	80+	2,604	4.2
Marital status: Presence of spouse or partner (130)	No	24,857	39.8
	Yes	37,601	60.2
Education (611)	High school or less	26,542	42.8
	More than high school	35,435	57.2
Immigrant (256)	No	51,963	83.4
	Yes	10,369	16.6
GP visits over past 12 months (393)	3 or fewer	39,305	63.2
	more than 3	22,890	36.8
Pain (104)	None	53,224	85.2
	Any	9,260	14.8
Health status	Best	38,232	61.1
	Less well	24,356	38.9

TABLE 4
Respondent characteristics (age 20 and over) associated with not acknowledging relevant self-reported drug categories when the specific drug product is expected to be in that category

		The odds of those in the specific drug categories not being in the corresponding self-reported drug use categories – OR calculated by logistic regression							
		Sex	Age: 20 year age groups	Marital status	Education: high school completion	Immigrant	GP visits in past year	Pain	Health status
	N (# missing observations)	F/M	Older/ younger	Partner/ no partner	Only/ more	Yes/No	3+ visits/ fewer	Any/none	Good/ less
1. Insulin/oral diabetic drugs	1,133 (26)	0.7	1.1	0.7	0.9	0.8	0.6	1.1	0.7
2. Thyroid	1,954 (42)	0.5	1.4*	0.6*	0.9	1.6	1.4	0.8	1.0
3. Analgesics	5,791 (118)	0.8	1.6*	0.9	0.8	0.9	1.4*	0.7*	1.2
4. Heart	1,019 (31)	1.2	0.9	1.2	1.3	1.1	0.5*	0.8	0.7
5. Asthma	853 (18)	1.0	1.2	1.6	1.1	0.7	0.9	1.9*	1.2
6. Antihypertensives	5,772 (128)	0.6*	1.0	1.0	1.0	1.1	0.9	1.1	1.1
7. Antidepressants	1,513 (33)	1.1	1.9*	1.1	0.6*	0.7*	0.7	1.3	1.0
8. Antibiotics	964 (18)	1.2	1.3*	0.7*	0.8	1.1	1.0	1.1	0.9
9. Tranquillizers/sedatives	912 (19)	1.1	0.9	1.0	0.8	0.8	0.7	0.8	1.0
10. Narcotic analgesics	1,015 (16)	0.9	1.5*	1.3*	0.6*	0.8	0.8	0.6*	0.9

* Statistically significant at $p < 0.05$

antidepressant use in the self-reported category. Each model contains each of the variables listed across the top of the table as independent variables. All variables, except for age, have been dichotomized. The youngest age group is the referent category. The category after the slash is the referent category for the other variables. Confidence limits have not been provided because it would not only result in an immense table, but it would also make it more difficult to scan the table for patterns.

In terms of the table contents, the most consistent result for the various drug categories is for age, where five of the 10 drug use categories showed a statistically significant odds ratio (OR) above 1.0, indicating that older people were less likely to have answered "yes" to the relevant self-reported drug category. However, the other five ORs in the column are near 1.0. For other variables, e.g., marital status, there were statistically significant ORs in both directions. Thus, having a partner appeared to make one more likely to report having taken narcotic analgesics in the last 30 days, but less likely to report thyroid medication and antibiotics.

Discussion

The results showed that survey respondents did not always answer in the affirmative to the use of drugs in the appropriate drug category when one considers their answers to subsequent questions about specific drugs that they had indicated using. For example, 17.8% of those who indicated taking specific antibiotics did not answer "yes" to the question asking them whether they had used antibiotics in the previous month. Similarly, almost half of the people who reported taking a narcotic analgesic in the last two days had not reported taking drugs in the narcotic analgesic category, which included Demerol, morphine or drugs with codeine.

To evaluate potential reasons for these discrepancies we will initially examine the quality of the data collection. The self-reported category is based on a fairly general question. The answer would combine the ability to recall having used a drug with the ability to interpret the question with some insight into what drugs would be included in this general class of medication. Because of these factors, the opportunity to be able to interpret respondents' replies was an important one and one of the reasons why this study was undertaken.

The more precise request for the names of specific medications was designed to discover as close to a home inventory of medications as is possible in a telephone interview. There was still an element of recall, depending on whether respondents remembered having taken any drugs at all in the last two days (or wanted to be bothered) or whether they kept their drugs in one place, e.g., the medicine cabinet, or had to remember which were stored in various locations in the home. The same problems would arise in the case of an interviewer who

visits the home to take an inventory. The additional problem with a telephone survey is the need to read the label of the bottle and to be able to spell the sometimes difficult names. In general, the method of data collection in which the respondent is asked to collect all the containers and read the drug names off the labels would be the best possible approach for a telephone interview and as close to a home inventory as possible under the circumstances. Requesting both types of data within the same interview is an important opportunity to learn more about the meaning of these drug use questions and in particular the self-reported drug categories.

In spite of the data being reasonably accurate, it is clear from Table 2 that there is a considerable discrepancy between the self-reported drug use categories and the specific drug product categories, with the percentage of drugs reported in the latter categories varying from less than 5% to almost 50% for the various drug groups. A variety of reasons can be advanced for these discrepancies:

- *Forgetfulness*. The respondents may have forgotten that a drug was taken until they were asked to get all the containers. This would agree with de Jong et al.'s findings, in which the interviewer asked three successive drug use questions and found that more drugs were reported with each successive question.[8]
- *Different types of questions*. De Jong et al. found that different types of questions have different results, e.g., indication-specific and drug-specific questions were more accurate than open-ended questions.[8] The larger self-reported drug categories used in the present study tended to be somewhat more indication-specific than drug-specific, although the indication may be only implied or the question may be a mixture of indication- and drug-specific components. For example, when people were asked whether they took "penicillin or other antibiotics," the question provided a mixture of a product-oriented component, "penicillin," and an indication-oriented one, "antibiotics."
- *Terminology*. To what extent do people know that antibiotics are the drugs taken for infections? This may appear to be self-evident to researchers and health professionals but it is possible that the health care provider may have used a different terminology, e.g., "I will give you something for your bladder problem," or "I will give you something for your infection," without using the word "antibiotics."
- *Communication with health care providers*. There may have been other gaps in communication between the respondent and his or her health care provider. The physician prescribed a drug and the patient did not understand exactly why he or she was given the drug or may have misunderstood the reason for taking the drug.
- *Less obvious uses of the drug*. Related to this is the possibility that a drug may have been given for a purpose that is different from its primary indication: an antidepressant may have been prescribed for difficulty sleeping, for example, if the physician suspected that depression was at the root of the insomnia. The patient would have thought of this drug as a sleeping pill rather than an antidepressant. Another example is that people taking acetylsalicylic acid (ASA) for prevention of heart problems might not have considered ASA to be an analgesic under the circumstances.
- *Wording/order of the questions*. One wonders whether suggesting a particular drug as an example of a drug category was helpful or whether it was more likely to confuse people. Was it useful or counterproductive to ask people whether they were taking tranquillizers such as Valium? People may never have heard of Valium, or if they had, what they heard may not have been very positive. They may not have realized that Ativan is the same type of drug as Valium and, in any case, they may not have wanted to admit that they were taking the same type of drug. In terms of order of questions, one would think that asking whether respondents were taking "medicine for blood pressure" followed immediately by a separate question about taking "diuretics or water pills," which are also mainly used as antihypertensives, could easily have led to confusion.

The series of logistic regression models did not present a consistent pattern of respondent characteristics that were associated with the presence or absence of the discrepancy between the two methods of collecting drug use information. For five of the drug categories older age seems to have been associated with the discrepancy, however, for the other five the OR was near 1.0. The other variables did not show any statistically significant association or may have shown statistically significant association in both directions for the same variable. The discrepancies between the two types of drug use measures were most likely a type of bias, e.g. collection bias rather than a factor that could have been calculated and allowed the use of the percentage as a correction factor. Asking the question in a different way may well have altered the results considerably.

These findings have important implications, both in terms of interpreting the results of a survey of this type and for planning further surveys with drug use questions. First of all, asking about specific drug products only from people who answered "yes" to any of the self-reported drug categories very likely leads to under-reporting of the latter, especially given the percentages in the last column of Table 2 where specific drugs are reported that were not included in the self-reported categories. Secondly, planners need to carefully consider what information on drug use they want to obtain from the survey. Asking about drug use categories rather than specific drug names will make the survey much easier to complete and will cut down the amount of time needed to complete the questionnaire. However, if one really wants to know what proportion of the elderly take BZD, then a category question about tranquillizers and

sedatives as used in this survey will be misleading, as seen in Table 2. On the other hand, if one wants to know what proportion of people are treating their difficulty in sleeping with medication, then the question is fine as long as we realize that this is not a well-defined category in terms of the names of actual drugs.

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Book Reviews

Genetics and Public Health in the 21st Century: Using Genetic Information to Improve Health and Prevent Disease

Edited by Muin J Khoury, Wylie Burke and Elizabeth J Thomson
New York: Oxford University Press, 2000;
xx + 615 pp; ISBN 0-19-512830-3; $104.00

Advances in human genetics, due in large part to the Human Genome Project, are finding their way into health care and medical practice at breathtaking speed. There is great excitement as to the potential uses of genetic knowledge in disease prevention and health promotion. Now is the time for public health professionals to take leadership in the exploration of the best use of the knowledge obtained from genetics research to promote health and prevent disease.

This book is both timely and comprehensive in addressing issues related to genetics and public health, and, most importantly, providing a reality check to the excitement and heightened expectations that have accompanied human genetics advances. It identifies the current situation and knowledge and points out the gaps in this complex area and the challenging work that remains to be done. It provides a multidisciplinary overview and stresses the importance of interdisciplinary collaboration. Although its focus is on public health, the book skilfully presents all aspects of human genetics, including ethical, legal, educational and social issues. It gives consumers a voice and emphasizes the importance of their inclusion in policy development.

Genetic services are not new to health care. They have historically been available as part of the reproductive and prenatal health care services. The focus has been primarily on rare single-gene Mendelian disorders. Genetic services are now undergoing a shift of focus to common complex conditions of major public health importance such as heart disease, diabetes, certain types of mental illness, neurological conditions, and cancer. The book, which is addressed to public health students, researchers and health practitioners, provides a solid foundation for integrating advances in human genetics into public health and medical practice. The contributors come from a variety of disciplines, reflecting the multidisciplinary nature of this field.

The text is divided into six parts, reflecting the functions of public health: Genetics and Public Health: An Overview; Public Health Assessment; Evaluation of Genetic Testing; Developing, Implementing, and Evaluating Population Interventions; Genetics and Public Health: Ethical, Legal and Social Issues; and Communication, Education, and Information Dissemination.

The first chapter of Part 1 offers a framework for the integration of human genetics into public health practice. Although the perspective of the book is mainly American, it is generic enough to be applied and adapted to fit the particular setting of a given country. The framework is built on the four public health functions relevant to human genetics, namely public health assessment (surveillance and epidemiology), evaluation of genetic testing, development, implementation and evaluation of population interventions, and communication and information dissemination. Critical issues in genetics and public health are also identified and discussed. The chapter presents examples of studies that are currently being carried out or that are needed, and identifies existing collaborative efforts. The remaining chapters cover the historical perspectives and current challenges and opportunities; the Human Genome Project, its evolving status and emerging opportunities for disease prevention; models of public health genetic policy development; and the multidisciplinary nature of public health genetics in research and education. The book presents fresh ideas for approaching medical and epidemiological research and reflects the multidisciplinary reality and complexity of issues with regard to human genetics and public health.

Part 2 addresses public health assessment in depth, and each chapter is devoted to a particular discipline or area. Chapter 6 focuses on epidemiology and molecular biology. It provides examples of applications of molecular epidemiology in public health and of successful collaborations between multiple disciplines. It also discusses the necessary educational requirements to increase the genetics literacy of epidemiologists, public health professionals and the public. Chapters 7 and 8 discuss surveillance issues for birth defects and genetic diseases, and for hemophilia and inherited hematologic disorders,

respectively. Chapter 9 presents the public health assessment of genetic predisposition to cancer. Cancer control is faced with a new paradigm that comprises the identification and modification of environmental risk factors among people with an inherited susceptibility to cancer. This chapter offers an overview of the present understanding of the genetics of common malignancies and highlights the gaps that have yet to be addressed. Similarly, Chapter 10 focuses on the public health assessment of genetic susceptibility to infectious diseases, malaria, tuberculosis, and HIV, and gives good detailed information on the integration of host genetic information into the prevention and control of infectious diseases. Chapter 11 addresses the public health assessment of genetic information in the occupational setting, especially with regard to research and regulation issues.

Part 3 is devoted to the evaluation of genetic testing. For clinicians, genetic testing is the most readily applied and most frequently encountered application of human genetics discoveries. The importance of ensuring safe, effective and quality genetic testing is a priority currently facing public health professionals. Chapter 12 provides medical and public health strategies for ensuring the quality of genetic testing and presents the personnel requirements, educational needs and competency determination for the providers of genetic testing. Chapter 13 describes newborn screening quality assurance programs and discusses issues related to the banking and use of dried-blood spots for DNA testing.

Part 4 encompasses the development, implementation and evaluation of population interventions, which are the ultimate goal of using genetic knowledge to promote health and prevent disease. This is where the book is the most applied and relevant to the purposes of public health functions. Chapter 14 describes the "dos and don'ts" of public health needs assessment. Issues regarding access to genetic services are discussed in Chapters 15 to 17. Chapter 18 presents prevention effectiveness models and how to critically evaluate them. Chapters 19 to 24 deal with various aspects of public health strategies aimed at promoting health and preventing disease, using specific examples of newborn screening programs and adult onset diseases. This part of the book presents the challenges of implementing public health interventions particularly well and does not shy away from identifying the hurdles already encountered by some efforts, such as the lack of behaviour modification in individuals who tested positive for a genetic predisposition to a given condition. The book does propose ways to address some of the hurdles and identifies where more evidence and research are needed.

Part 4 also provides a somewhat international overview of genetic efforts in the Netherlands and in developing countries. It is unclear why the situation in the Netherlands was chosen to be included in this book, other than to discuss the concept of "community genetics." Other countries, such as the United Kingdom and Australia, which have done some work and produced documents on genetics and genetic testing, were not included in the book. The Canadian situation is not presented either. Canada is just beginning to address issues related to genetic testing for late onset diseases.

Although the ethical, legal and social issues surrounding genetics and public health are discussed throughout the book, Part 5 addresses these topics in more depth, covering genetics, public health and the law; informed consent beyond the clinical encounter; the public health surveillance of genetic information; and the ethical and legal responses to social risk.

Part 6, on communication, education and information dissemination, covers the basic requirements of the communication processes and outcomes of genetic medicine in a public health framework, in keeping with ethical and social responsibilities. It also outlines the transactional model of communication and its applications to public health genetics. Chapter 29, on training in public health genetics, addresses the educational requirements of many public health disciplines and recommends future directions. Chapter 30 presents the consumer perspective on genetic testing, with personal accounts that remind readers of the real people behind all the policies and programs. The chapter discusses the role of consumers in the policy implications of genetic testing. Finally, Chapter 31 deals with using the Internet to disseminate genetic information for public health.

Advances in the study of human genetics are permeating every discipline involved in public health. Inevitably, all public health professionals will be required to integrate human genetic research, policy and program development into their daily work. This valuable book will be of great assistance to them in doing so.

Overall rating:	Excellent
Strengths:	Timeliness Comprehensiveness Reality check amidst all the excitement about human genetics Multidisciplinary Depth
Weaknesses:	No basic genetics information or glossary
Audience:	Public health students, researchers and practitioners

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Spatial Epidemiology: Methods and Applications

Edited by P Elliott, JC Wakefield, NG Best and DJ Briggs
Oxford: Oxford University Press, 2000;
xviii + 463 pp; ISBN 0-19-262941 7; $127.50

There is a growing interest in the field of population health and a general acceptance that a wide range of factors, or determinants, influence health outcomes. A number of these determinants, such as particulate air pollution, have distinctive patterns of space, while others, such as income inequality or residential segregation, are attributes of places. In order to understand the influence of these determinants it may be most efficient, and in some cases essential, to use spatial studies. Unfortunately, space has received little attention in the discipline of epidemiology, which is why it is refreshing to see a book like *Spatial Epidemiology*.

First, I would like to clarify what this book is and is not. While it does include 25 chapters on various aspects of spatial epidemiology, it is not "a comprehensive reference on ... the field of spatial epidemiology," as the jacket advertises. In fact, the editors make this clear by declaring in the first chapter that the focus is on small-area studies. They go on to give arguments as to why small-area studies are better than other types of spatial analyses. Fortunately this thread of argument is not carried through the rest of the text, though most of the chapters do centre on small-area studies.

Nevertheless, the book is a useful reference for researchers interested in spatial epidemiology. There are four sections: health and population data, statistical methods, disease mapping and clustering, and exposure and the link to health.

The chapters in the first section cover issues that arise in using spatial data: inaccuracies in geocoding, differences in coding health outcomes between administrative areas, problems in census data, ascertainment bias caused by migration, socio-economic confounding of environmental exposures, non-uniform exposure within areas, spatial dependence and the modifiable area unit problem (MAUP). While the specific examples used are predominantly small-area studies, the issues are important to any type of spatial analysis. However, two important discussions are missing from this section: contextual variables and scale.

The second section presents a smorgasbord of statistical methods that will make any spatial epidemiologist's mouth water. While this section also focuses on small-area studies and cluster detection, there is an entire chapter devoted to ecological correlation studies. I commend the authors for providing many comparative examples of methods in action, and their bibliographies alone are worth the cover price of this book. However, the discussion is pitched over the heads of people new to the area of spatial statistics and few guidelines are provided on which methods are best used for which study questions or research contexts.

The third section mostly concerns disease mapping, its history, methodology, and problems with working with rare diseases or infectious diseases. These chapters bring up important questions in creating a map – what type of map, what area to use, what relative risk or rate to show, what colours or symbols to choose – and outline ways to answer them. Tacked on to the end are two chapters on cluster detection. The first (chapter 17) provides an excellent overview of clustering from a theoretical and historical perspective with lots of concrete examples of cancer cluster studies. It also explains the reasons to search for and examine clusters. The second chapter is the only one in the book to deal with scale in any sort of detail, illustrating the differences in the results of childhood leukemia studies conducted at different scales. Together, these chapters provide an excellent introduction to cluster analyses.

The final section deals with exposure assessment, covering personal monitors, micro-media and ambient monitors, interpolation methods (in particular kriging), dispersion modelling, the use of remote sensing data and time-activity analysis. Three examples of fields where spatial epidemiology is useful are included: air pollution and the SAVIAH study, drinking water risks, and health risks posed by climate change. However, the drinking water chapter is disappointing because it manages to discuss issues in exposure assessment without addressing any spatial aspects. Chapter 20, on personal monitoring, also seems out of place in this book because it does not deal with spatial concepts. Happily, the remainder of this section is solid, and through examples, finally gets to the reasons for spatial epidemiology, a topic perhaps better placed at the beginning of the book.

Spatial epidemiology is still a new field and while this book provides a useful reference for researchers already conducting spatial studies, it is unlikely to engage those who have yet to realize the relevance of such work. For instance, a discussion of integral and contextual variables,[1] which are valid measures of an areal attribute, would be both relevant to a discussion of spatial data

issues as well as provide an opportunity to argue for the use of spatial analyses.

Although there is useful information in this book, it lacks coherence. The chapters read as stand-alone articles rather than as part of a whole, to the extent that some topics (such as the MAUP) are covered ad nauseam and others (such as scale) are barely touched. What it lacks is a sense of a shared set of principles among the authors. The book left me wanting to know why the authors think space is important to the study of health, and how spatial concepts, such as scale and spatial dependence, define the research they conduct.

Overall rating: Good

Strengths: Provides a toolbox for researchers wanting to conduct spatial analyses, especially small-area studies.

Weaknesses: Lack of coherence among the chapters. No explanation of why and when spatial analyses should be conducted. Little discussion of basic geographical concepts and theories.

Audience: Health researchers, GIS technicians, and statisticians who are already engaged in, or interested in conducting spatial epidemiological research. Some individual chapters may be useful to a wider audience.

References

1. Susser M. The logic in ecological: the logic of analysis. *Am J Public Health* 1994;84(5):825-829.

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New Resource

Now Available from Statistics Canada

Occupational Surveillance in Canada: Cause-Specific Mortality Among Workers, 1965–1991
(Catalogue No. 84-546-XCB; $500)

Statistics Canada has released an easy-to-use bilingual CD-ROM entitled *Occupational Surveillance in Canada: Cause-Specific Mortality Among Workers, 1965–1991*. This product describes the impact of 670 different occupations on 70 different causes of death for women and men.

This valuable tool provides the information you need to

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The data can be reviewed in prepared tables (in EXCEL) or can be manipulated from an ASCII file into the spreadsheet of your choice.

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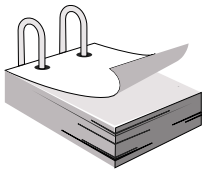
Available for $500 plus applicable taxes in Canada or US$500 plus shipping charges if ordered outside Canada. Order toll-free by phone at 1 800 267-6677, by fax at 1 877 287-4369, by mail from Statistics Canada, Dissemination Division, Circulation Management, 120 Parkdale Avenue, Ottawa, ON K1A 0T6 or by e-mail at order@statcan.ca.

For further information, see http://www.statcan.ca/english.IPS/Data/84-546-XCB.htm.



Calendar of Events

March 2–3, 2001 **Vancouver, British Columbia**	"Women and Cancer: Myths and Realities" Sponsored by Interprofessional Continuing Education, UBC	Interprofessional Continuing Education, UBC Tel: (604) 822-0054 Fax: (604) 822-4835 E-mail: rachel@cehs.ubc.ca
April 1–3, 2001 **Banff, Alberta**	"Optimal Therapeutics Through Evaluation, Policy and Practice" Annual Meeting of the Canadian Association for Population Therapeutics (CAPT) *Abstract deadline: December 15, 2000*	Kris Schindel E-mail: kschindel@interbaun.com <www.capt-actp.com>
May 13–18, 2001 **Toronto, Ontario**	9th International Women and Health Meeting York University Campus	Monica Riutort, Coordinator Canadian Planning Committee Tel: (416) 323-6249 Fax: (416) 323-7318 E-mail: monicari@web.net
June 13–16, 2001 **Toronto, Ontario**	Congress of Epidemiology 2001 Combined meeting of American College of Epidemiology, American Public Health Association's Epidemiology Section, Canadian Society for Epidemiology and Biostatistics and Society for Epidemiologic Research	<www.epi2001.org>
July 1–6, 2001 **Vancouver, British Columbia**	"Global Aging: Working Together in a Changing World" 17th Congress of the International Association of Gerontology *Abstract deadline: December 31, 2000*	Congress Secretariat Gerontology Research Centre Simon Fraser University 2800 – 515 West Hastings Street Vancouver, BC V6B 5K3 Tel: (604) 291-5062 Fax: (604) 291-5066 E-mail: iag_congress@sfu.ca <www.harbour.sfu.ca/iag>
July 15–20, 2001 **Paris, France**	"Health: an investment for a just society" XVII World Conference on Health Promotion and Health Education International Union for Health Promotion and Education *Abstract deadline: November 30, 2000*	Martine Lapergue Réjane Jouan Comite francais d'Éducation pour la Santé (CFES) XVII World Conference on Health Promotion and Health Education 2, rue Auguste Comte – 92174 VANVES Cedex – FRANCE Tel: 33 (0)1 41 09 96 48 Fax: 33 (0) 1 46 45 00 45 E-mail: mlapergue.cfes@imaginet.fr <www.iuhpe.org>

September 4–7, 2001 **Atlanta, Georgia, USA**	"Using Science to Build Comprehensive Cancer Programs: A 2001 Odyssey" US Department of Health and Human Services Centers for Disease Control and Prevention 2001 Cancer Conference	Laura Shelton Professional & Scientific Associates 480 – 2957 Clairmont Road, Suite 480 Atlanta, GA 30329 E-mail: L_Shelton @psva.com
November 29–December 1, 2001 **Toronto, Ontario**	Canada's Fifth National Conference on Asthma and Education (ASED 5) *Abstract Deadline: June 30, 2001*	A. Les McDonald, Executive Director Canadian Network for Asthma Care (CNAC) 1607 – 6 Forest Laneway North York, Ontario M2N 5X9 Tel: (416) 224-9221 Fax: (416) 224-9220 E-mail: ased@cnac.net <www.cnac.net>

Canada's Fifth National Conference on Asthma and Education (ASED 5)

will be held November 29–December 1, 2001
at the Sheraton CentreToronto, Toronto, Ontario

Deadline for abstract submissions is June 30, 2001

Preliminary program, registration and hotel reservation forms, abstract submission form and other information may be accessed at the CNAC/ASED 5 Web site at www.cnac.net

For the preliminary program package and other information, please contact
A.Les McDonald, Executive Director
Canadian Network For Asthma Care (CNAC)
1607 – 6 Forest Laneway, North York, ON M2N 5X9
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Announcement

Included with this issue is Wave 2 of the Canadian Tobacco Use Monitoring Survey. The survey was developed to provide Health Canada and its partners with timely, reliable and continual data on tobacco use and related issues. The survey's primary objective is to track changes in smoking status and amount smoked, especially for populations most at risk. Fact sheets based on Wave 1 were released in January 2000. These latest findings are based mainly on the full-year data (February–December 1999) for which Statistics Canada interviewed approximately 22,000 persons.

ERRATUM

Volume 21, No. 3, Fall 2000

"The Prevalence of Diabetes in the Cree of Western James Bay"

Dr. Will King, co-author of the above-mentioned article, was incorrectly listed in the author references as being affiliated with the Department of Ophthalmology at the University of British Columbia in Vancouver, British Columbia. He is currently affiliated with the Department of Community Health and Epidemiology at Queen's University in Kingston, Ontario.

CONGRESS OF EPIDEMIOLOGY 2001

Please join us in Toronto June 13–16, 2001, for our first combined meeting.

- American College of Epidemiology
- American Public Health Association (Epidemiology Section)
- Canadian Society for Epidemiology and Biostatistics
- Society for Epidemiologic Research

Congress 2001 Themes

Advances in design and analysis of epidemiologic investigations
Policy issues that threaten the conduct of epidemiology
Fall and re-emergence of infectious disease
Ethics and standards of practice for epidemiology
Evidence-based health care—the central role of epidemiology
Epidemiology and the law: concepts of causality in conflict
Epidemiology and molecular genetics: "Wave of the future or Tsunami"

Planning Committee

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Web site: <www.epi2001.org>

CDIC: Information for Authors

Chronic Diseases in Canada (CDIC) is a peer-reviewed scientific journal published four times a year. Contributions are welcomed from outside of Health Canada as well as from within this federal department. The journal's focus is the prevention and control of non-communicable diseases and injuries in Canada. This may include research from such fields as epidemiology, public/community health, biostatistics, behavioural sciences and health services. CDIC endeavours to foster communication about chronic diseases and injuries among public health practitioners, epidemiologists and researchers, health policy planners and health educators. Submissions are selected based on scientific quality, public health relevance, clarity, conciseness and technical accuracy. Although CDIC is a Health Canada publication, authors retain responsibility for the contents of their papers, and opinions expressed are not necessarily those of the CDIC Editorial Committee or of Health Canada.

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Regular Feature Articles: Maximum 4,000 words for main text body (excluding abstract, tables, figures, references) in the form of original research, surveillance reports, meta-analyses, methodological papers, literature reviews or commentaries

Short Reports: Maximum 1,200 words (as above)

Status Reports: Describe ongoing national programs, studies or information systems at Health Canada (maximum 3,000 words)

Workshop/Conference Reports: Summarize workshops, etc. organized or sponsored by Health Canada (maximum 3,000 words)

Cross-country Forum: For authors outside of Health Canada to exchange information from research or surveillance findings, programs under development or program evaluations (maximum 3,000 words)

ADDITIONAL ARTICLE TYPES

Letters to the Editor: Comments on articles recently published in CDIC will be considered for publication (maximum 500 words)

Book/Software Reviews: Usually solicited by the editors (500–1,300 words), but requests to review are welcomed

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Submit manuscripts to the Editor-in-Chief, *Chronic Diseases in Canada*, Population and Public Health Branch, Health Canada, Tunney's Pasture, CDIC Address Locator: 0602C3, Ottawa, Ontario K1A 0L2.

Since CDIC adheres in general (section on illustrations not applicable) to the **"Uniform Requirements for Manuscripts Submitted to Biomedical Journals"** as approved by the International Committee of Medical Journal Editors, authors should refer to this document for complete details before submitting a manuscript to CDIC (see **<www.cma.ca/publications/mwc/uniform.htm>** or *Can Med Assoc J* 1997;156(2):270–7).

Checklist for Submitting Manuscripts

- ☐ **Cover letter:** Signed by all authors, stating that all have seen and approved the final manuscript and have met the authorship criteria of the Uniform Requirements and including a full statement regarding any prior or duplicate publication or submission for publication
- ☐ **First title page:** Concise title; full names of all authors and institutional affiliations; name, postal and e-mail addresses, telephone and fax numbers for corresponding author; separate word counts for abstract and text
- ☐ **Second title page:** Title only; start page numbering here as page 1
- ☐ **Abstract:** Unstructured (one paragraph, no headings), maximum 175 words (100 for short reports); include 3–8 **key words** (preferably from the Medical Subject Headings (MeSH) of *Index Medicus*)
- ☐ **Text:** Double-spaced, 1 inch (25 mm) margins, 12 point font size
- ☐ **Acknowledgements:** Include disclosure of financial and material support in acknowledgements; if anyone is credited in acknowledgements with substantive scientific contributions, authors should state in cover letter that they have obtained written permission
- ☐ **References:** In "Vancouver style" (consult Uniform Requirements and a recent CDIC issue for examples); numbered in superscript (or within parentheses) in the order cited in text, tables and figures; listing up to 6 authors (first 3 and "et al." if more); ***without any automatic reference numbering feature used in word processing***; any unpublished observations/ data or personal communications used (discouraged) to be cited in the text in parentheses (authors responsible for obtaining written permission); authors are responsible for verifying accuracy of references
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- ☐ **Number of copies:** Four complete copies, including tables and figures; 2 copies of any related supplementary material

Chronic Diseases in Canada

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