reports to the NMHED. The high rates of reporting of laboratory-confirmed cases documented in this study demonstrate that the system is working efficiently.

Connell, *et al*, have described the opportunities and hazards in the use for research of datasets designed and compiled for other purposes.[6] Our study exemplifies such limitations. Although ICD-9-CM code assignments were not sensitive for detection and surveillance of the notifiable infectious diseases we chose for this study, they were congruent with the clinical picture and may have identified potential cases not detected by laboratory-based surveillance. Conditions whose diagnoses rely predominantly on clinical evidence (e.g., injuries) are likely to be more accurately identified by ICD-9-CM code surveillance. Although further studies on the feasibility of inpatient and outpatient data systems for surveillance are needed, access to a dataset combining laboratory, inpatient, and outpatient information holds potential for disease surveillance. □

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Physical Activity on the Job and Cancer in Missouri

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ABSTRACT

We conducted a series of case-control studies to investigate the risks of 16 cancer types in relation to occupational physical activity. These studies were based on Missouri Cancer Registry data for 17,147 White male cancer patients registered between 1984 and 1989. Colon cancer risk was increased for both the moderate (odds ratio (OR) = 1.1; 95% confidence interval (CI) = 1.0, 1.3) and low (OR = 1.2; 95% CI = 1.0, 1.5) activity levels. Similar elevations were observed for prostate cancer at the moderate (OR = 1.1; 95% CI = 1.0, 1.3) and low (OR = 1.5; 95% CI = 1.2, 1.8) levels of activity, and for cancer of the testis at the low activity level (OR = 2.2; 95% CI = 1.3, 3.7). An opposite trend ($p < 0.01$) was noted for lung cancer, which showed decreased risk at the moderate (OR = 0.9; 95% CI = 0.8, 1.0) and low (OR = 0.8; 95% CI = 0.6, 0.9) activity levels. These associations suggest that further study of the relationship between physical activity and site-specific cancer risk is warranted. (*Am J Public Health* 1991;81:639–642)

Introduction

A growing body of evidence suggests an inverse relation between physical activity and risk of colon cancer. Recent studies,[1–11] from diverse populations, have identified an association between occupational or recreational physical activity and colon cancer risk, although one report found no such relation.[12] Elevations in risk of colon cancer in relation to low physical activity have typically ranged from 20-100 percent.[1–11]

Few studies have evaluated the association between physical activity and other types of cancer. Recent findings suggest that physical activity may be associated with several cancer types including cancer of the stomach,[8] prostate,[9] and breast.[10–13]

To investigate the risks of various cancer types in relation to occupational physical activity, we conducted a series of case-control studies based on data from a statewide cancer registry.

Methods

Subjects were identified through the Missouri Cancer Registry for the time period January 1984 through May 1989. The Registry is maintained by the Missouri Department of Health and has been collecting data on incident cancer cases from public and private hospitals since 1972. Hospital reporting has been mandated by law since 1984. Reporting procedures and validity issues have been discussed in more detail elsewhere.[14]

The current study involved a series of case-control studies that included White male cancer patients who were 20 years of age or older at the time of diagnosis. Men with cancer of ill-defined and unknown primary sites (*International Classification of Diseases for Oncology*[15] (ICD-O) codes 195 and 199) were excluded. Selection was limited to White males due to the small

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TABLE 1—Number of Cancer Patients by Site in Missouri Males, 1984–89

Sites	ICD-O codes		Number of Cases
	Topography	Morphology	
Buccal cavity	140–149		585
Esophagus	150		237
Stomach	151		358
Colon	153		1,838
Rectum	154		812
Pancreas	157		409
Larynx	161		335
Lung	162		4,700
Malignant melanoma		8720/3	143
Prostate	185		2,878
Testis	186		252
Bladder	188		1,080
Kidney/other urinary organs	189		515
Brain/other nervous system	191, 192		332
Non-Hodgkin's lymphoma		*	536
Leukemia		9800/3-9940/3	438
Other cancers			1,699
Total			17,147

*Non-Hodgkin's lymphoma working formulation.[17]

number of other races and the lack of occupational diversity among females.

Data on occupation and tobacco use are routinely abstracted from the hospital medical record at the time of diagnosis for the Missouri Cancer Registry. Hospital registrars record employment information for cancer patients using a standardized protocol. These data are subsequently coded by trained cancer data specialists on the Registry staff using the three-digit 1980 US Census codes.[16] The smoking history of each patient is characterized according to status (i.e., never, former, or current use) and, among current smokers, according to the number of packs smoked per day.

Analysis was limited to 17,147 subjects from the Registry who had codable occupational information. The remaining subjects had no occupational information or noninformative job titles such as "retired."

The classification scheme of Garabrant *et al.*[1] with modifications for Missouri work requirements,[11] was used to categorize occupations according to the level of physical activity. Individual occupations were classified according to whether physical activity is required more than 80 percent of the time (high activity), 20–80 percent of the time (moderate activity), or less than 20 percent of the time (low activity). Subjects were then assigned to one of the three activity levels.

In the analysis for each cancer site, all other cancer registrations formed the control group. For example, in the analysis of the buccal cavity (ICD-O codes 140-149), the case group consisted of 585 patients with this cancer type and the control group consisted of 16,562 "other" cancer patients. The distribution of study subjects by cancer type is shown in Table 1.

Maximum likelihood estimates of the odds ratio (OR)[18] were adjusted for age and smoking, and trend tests were conducted.[19] The highest level of activity was used as the reference category.

In calculating site-specific ORs, colon cancer was excluded from the control group since physical activity has been consistently shown to be a risk factor for colon cancer.[1–11] In addition, because some nonsedentary jobs may be at increased risk of lung cancer due to carcinogenic exposures, ORs for physical activity and lung cancer were adjusted according to *a-priori* job assignments. Occupations were assigned to a high-risk or low-risk category based on a previous study of occupation and lung cancer in Missouri.[20]

Results

Table 2 presents the risks of various cancer types according to the level of occupational physical activity. Elevated colon cancer risk was observed for both the moderate (OR = 1.1; 95% confidence interval (CI) = 1.0, 1.3) and low (OR = 1.2; 95% CI = 1.0, 1.5) levels of activity, with an inverse trend ($p = 0.05$) in risk. Among anatomic subsites of colon cancer, risk was highest for cancer of the cecum, with an OR of 1.3 (95% CI = 0.9, 1.9) at the moderate activity level and an OR of 1.8 (95% CI = 1.0, 3.0) at the low activity level.

Similarly, prostate cancer showed increased risk for moderate (OR = 1.1; 95% CI = 1.0, 1.3) and low (OR = 1.5; 95% = 1.2, 1.8) activity levels. Elevated risk of cancer of the testis was noted for the low activity level (OR = 2.2; 95% CI = 1.3, 3.7). Inverse linear trends were observed for cancers of the prostate ($p < 0.01$) and testis ($p < 0.01$).

An opposite trend ($p < 0.01$) was seen for lung cancer. Decreased risk was shown for moderate (OR = 0.9; 95% CI = 0.8, 1.0) and low (OR = 0.8; 95% CI = 0.6, 0.9) activity levels. Of the major histologic types of lung cancer, the strongest gradient in risk was shown for squamous cell carcinoma. For this cell type, the OR for moderate activity was 1.0 (95% CI = 0.8, 1.1) and the OR for low activity was 0.6 (95% CI = 0.4, 0.8), with a significant gradient in risk ($p < 0.01$).

Discussion

This study corroborates recent studies[1–11] that suggest a relation between low physical activity and colon cancer risk although risk estimates were lower than those reported in some previous studies. Other possible associations were identified between physical activity and cancers of the prostate, testis, and lung.

The physiologic mechanism by which physical activity decreases colon cancer risk is not yet clearly defined but it may relate to increased colon peristalsis[21] and a subsequent decrease in the transit time of the stool and the accompanying exposure of the colon to fecal carcinogens.[4] In addition, experimental animal studies suggest a decreased incidence and growth of induced and transplanted tumors associated with higher levels of physical activity.[22,23]

We found inverse associations between occupational physical activity and cancers of the prostate and testis. Albanes *et al.*[9] recently reported a significant inverse relation between recreational exercise and prostate cancer risk. Previous studies of occupational mortality from Washington State[10] and among San Francisco longshoremen[12] have shown some evidence of a relation between prostate cancer and low job activity. However, other studies[8–12] have shown little evidence of a physical activity-prostate cancer association. The only previous study that investigated physical activity and can-

TABLE 2—Odds Ratios* and 95% Confidence Intervals for Cancer according to Occupational Physical Activity Level in Males, Missouri, 1984–89

Site	Activity Level	Number of Cases	Odds Ratio	95% Confidence Interval	Trend p value
Buccal cavity	moderate	457	1.0	0.8, 1.2	
	low	42	1.1	0.8, 1.7	0.37
Esophagus	moderate	189	1.0	0.7, 1.4	
	low	11	0.7	0.3, 1.4	0.18
Stomach	moderate	281	1.0	0.8, 1.4	
	low	28	1.4	0.9, 2.2	0.13
Colon	moderate	1,476	1.1	1.0, 1.3	
	low	120	1.2	1.0, 1.5	0.05
Rectum	moderate	646	1.1	0.9, 1.3	
	low	55	1.2	0.8, 1.7	0.16
Pancreas	moderate	339	1.3	1.0, 1.8	
	low	22	1.1	0.6, 1.9	0.17
Larynx	moderate	274	1.0	0.7, 1.4	
	low	11	0.5	0.3, 1.0	0.08
Lung	moderate	3,687	0.9	0.8, 1.0	
	low	230	0.8	0.6, 0.9	<0.01
Malignant melanoma	moderate	111	1.0	0.6, 1.6	
	low	11	1.2	0.5, 2.6	0.39
Prostate	moderate	2,301	1.1	1.0, 1.3	
	low	200	1.5	1.2, 1.8	<0.01
Testis	moderate	189	1.1	0.8, 1.7	
	low	31	2.2	1.3, 3.7	<0.01
Bladder	moderate	865	1.1	0.9, 1.3	
	low	66	1.1	0.8, 1.5	0.28
Kidney/other urinary organs	moderate	413	1.2	0.9, 1.5	
	low	36	1.3	0.9, 2.0	0.10
Brain/other nervous system	moderate	256	1.0	0.7, 1.3	
	low	27	1.3	0.8, 2.1	0.27
Non-Hodgkin's lymphoma	moderate	425	1.0	0.8, 1.4	
	low	37	1.2	0.8, 1.8	0.23
Leukemia	moderate	346	1.0	0.8, 1.3	
	low	28	1.1	0.7, 1.7	0.47
Other cancers	moderate	1,384	1.2	1.0, 1.4	
	low	95	1.0	0.8, 1.3	0.24

*Adjusted for age, smoking, and carcinogenic job assignment (lung cancer only); the high activity level was the reference category.

cer of the testis was the study of Harvard and University of Pennsylvania alumni[12] in which no association was observed.

We found a positive association between occupational physical activity and lung cancer risk, although uncontrolled confounding for smoking habits may be partially responsible for this relationship. Earlier studies[8,9,12] have shown a general tendency toward decreased lung cancer risks associated with various measures of higher physical activity levels, although findings have not been entirely consistent.

Severson *et al.*[8] recently reported an increased risk of stomach cancer in relation to several measures of physical activity. These Missouri data showed no evidence of a physical activity-stomach cancer association. We found a slight association between low physical activity and rectal cancer risk, which has been reported inconsistently in previous reports.[1,2,8–10,12]

Our study has several limitations. We used occupational information collected in conjunction with cancer incidence reporting to produce a surrogate measure of physical activity. However, a recent study[14] that compared risk factor information contained in the Registry record with that obtained by interview found reasonable agreement for occupational data. We were also unable to adjust for some potential confounders such as socioeconomic status and dietary history. Although we lacked information on avocational physical activity, it has been reported that the majority of total physical activity in American workers occurs on the job.[24]

Major strengths of our study are the greater accuracy in hospital-reported tumor diagnosis, compared with death certificates,[25] and the ability to analyze data by histologic type or by anatomic subsite.

Our findings for cancers of the prostate, testis, and lung should be considered preliminary and require confirmation in other studies with more detailed measurements of physical activity and potential confounders. □

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Health Care Received by American Children: NCHS Report

The vast majority (83 percent) of American children are covered by health insurance, have a regular source of health care (88 percent, and visited a doctor in the past year for routine health care (64 percent) according to a recent report issued by the National Center for Health Statistics. The report cites new evidence, however, that America's minority and poor children receive less care, including preventive services.

The report—*Health Insurance and Medical Care: Health of Our Nation's Children, United States 1988*—is derived from data from the 1988 National Health Interview Survey on Child Health, conducted by NCHS. Questions on health insurance and sources of medical care were requested for all 17,110 children in a nationally representative sample of children 17 years of age and under.

The survey shows that Black newborns and infants were two to three times more likely to have lacked a routine visit for a check-up or any immunization during the first year of life than were White newborns and infants. Hispanic children were twice as likely to have no health insurance coverage, either public or private, as non-Hispanics.

Most children with a regular source of health care had private care; however, 16 percent of those children (8.7 million) received health care from hospital clinics, emergency rooms, walk-in or emergency centers or other clinics. Clinics were the source of care for 47 percent of Black infants, compared to 16 percent of White infants. For Hispanic infants, almost half received health care in clinics.

The report, *Health Insurance and Medical Care: Health of Our Nation's Children, United States, 1988*—is available from the National Center for Health Statistics, Centers for Disease Control, US Public Health Service, 6525 Belcrest Road, Hyattsville, MD 20782; (301) 436-8500.