

*A study was made of deaths from cancer of the stomach, colon, and rectum among residents of Manitoba during the period 1956-1965. Particular attention was given to occurrence in relation to ethnic characteristics. Findings suggest importance of host habits (dietary) and environmental factors rather than genetic factors. Direction of further research is discussed.*

## **ETHNIC DISTRIBUTION OF CANCER OF THE GASTROINTESTINAL TRACT IN MANITOBA**

*Nung Won Choi, M.D., M.P.H., Ph.D.*

### **Introduction**

**D**IFFERENTIAL incidence or variations in the geographic distribution of chronic diseases such as cancer have offered many clues to the etiology and pathogenesis of the disease concerned. Because of the inherent difficulties involved in morbidity studies of chronic disease, mortality data are used as a substitute in the evaluation of geographic distribution and population selectivity. However, the value of such attempts has been questioned, mainly because of differences in the reliability of diagnosis on, and the completeness of reporting and coding of, death certificates from country to country and even among geographic subdivisions within a country. Nevertheless, mortality studies are often advantageous, particularly when the case-fatality rate for a given disease is high and the survival period is relatively short, and where homogeneous medical practice is expected in an area, e.g., a province.

The Manitoba population presents an unusual opportunity for studying epidemiologic features of certain diseases of unknown etiology, not only because of

its representation of several distinctive ethnic groups and the relative stability of the inhabitants, but also because of the high level of medical practice throughout the province.

A near-complete case ascertainment of cancer via the Cancer Registry, which has existed for the last three decades, has constantly reflected the Manitoba physicians' conscientious cooperation in referring and reporting cancer cases. Correspondingly, near-complete and accurate case reports of cancer deaths on the official notification of death appear to be evident, based on the results of our preliminary exploration on comparability of death certificates to the registry in case ascertainment,<sup>1</sup> as shown in Table 1.

Because some epidemiologic variables, e.g., birthplace, racial origin, geographic locales, and so on, are readily accessible from the official certificates of death and their ready comparability to census information, analyses of Manitoba resident deaths from various major cancers were attempted as a preliminary effort. This communication is the initial part of a series of such efforts and deals with cancer of the gastrointestinal tract.

**Table 1.—Stomach cancer—comparability of diagnoses of death certificates and cases reported to the registry for the deaths occurring during 1960-1961, among Manitoba residents**

Definitiveness of diagnoses of registered cases	Total no. of deaths	%	Cases reported on death certificates									
			As having stomach cancer					As cancer of site other than stomach				
			Total		As contributory cause		As primary cause		As contributory cause		As primary cause	
			No.	%	No.	%	No.	%	No.	%	No.	%
Definite stomach cancer	228	69.7	216*	94.7	194	85.1	22	9.6	5†	2.2	7	3.1
Probable stomach cancer	42	12.8	41	97.6	39	92.9	2	4.8	0	0.0	1	2.5
Possible stomach cancer	57	17.4	54	94.7	49	85.9	5	8.8	1	1.8	2	3.5
Subtotal	327	100.0	311‡	95.1	282	86.2	29	8.9	6	1.8	10	3.1
			(98.7)									
Erroneously registered stomach cancer	13		4		3		1		5		4	
No. of total registered cases	340		315		285		30		11		14	

Criteria utilized for designation of definitiveness of diagnosis:

definite—microscopically diagnosed, biopsy and/or autopsy.

probable—clinically diagnosed with radiological support.

possible—registered cases without successful review of hospital records.

erroneously registered—review of hospital records revealed incorrect registration.

\* One case was cancer involving esophagus as well as cardia.

† Three cases were cancer involving esophagus as well as cardia.

‡ Numeral in the parenthesis indicates percentage of "likely" cases of stomach cancer among deaths certified as such.

## Material and Methods

The Manitoba Department of Health, Vital Statistics Section, provided us with official I.B.M. punch cards for Manitoba resident deaths from cancer of the stomach, colon, and rectum (ISC rubrics 151, 153, and 154), occurring during 1956-1965, inclusive for duplication of the cards for the current analyses. Compilation of deceased cases of such cancers occurring outside of Manitoba was not attempted as such cases are considered to be minimal.

Duplicated punch cards were sent to the University of Manitoba Computer Center for special tabulation. A program was constructed for the cross-tabulation by age, sex, birthplace, ethnic origin, and geographical divisions (20 divisions) and locales (urban vs. rural), and so on.

After tabulations were completed, numerical analyses were done by means of standardized mortality ratios (SMR's) computed, except otherwise specified. The "indirect method" was used. For the comparison of various countries, the 10-year age and sex-specific death rates for native-born and total Manitobans, utilizing 1961 census figures, were used as standard rates.

SMR's are expressed by observed number of deaths for a specific group, e.g., Scandinavian born, and so on, divided by expected number of deaths computed based on age- and sex-specific rates for native-born (for the foreign-born groups) and total Manitobans (for the ethnic groups), multiplied by 100. Ninety-five per cent confidence limits of the SMR's were calculated in order to determine statistical significance of calculated SMR's according to the special table prepared by Haenszel, et al.<sup>2</sup>

## Results

### 1. Stomach Cancer

A total of 1,727 Manitobans were reported to have died of stomach cancer

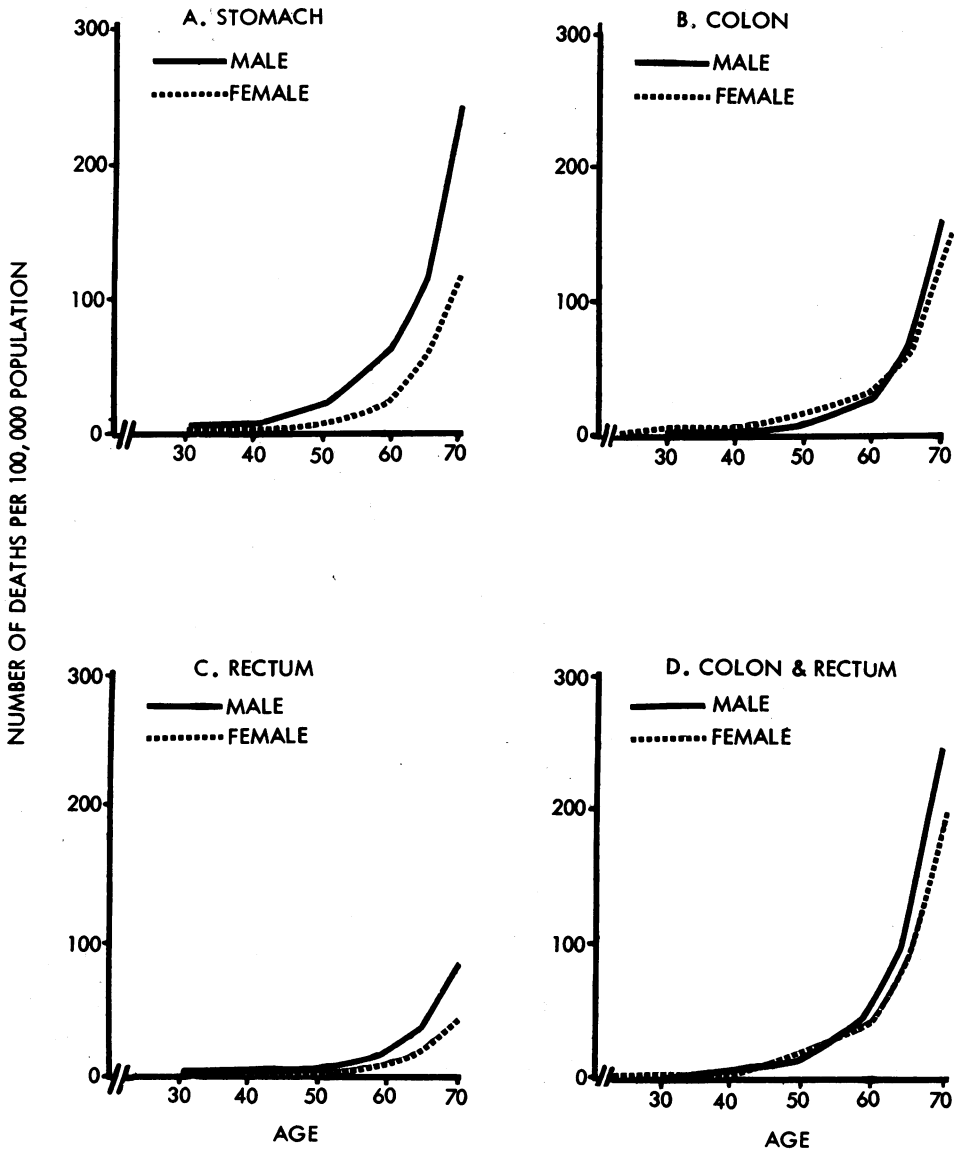
during the study years—stomach cancer listed as the primary or secondary cause of death. Average annual death rates were 25.6 and 11.7 per 100,000 population for males and females, respectively. Of 1,727 deaths, 1,198 (839 males and 359 females) were classified as foreign-born and 529 (359 males and 170 females) were classified as native-born. Thus approximately twice as many deaths (for each sex) were attributed to stomach cancer among foreign-born as compared to native-born population. Since the foreign-born population constitutes approximately 20 per cent of the total Manitoba population, the crude death rates (attributed to stomach cancer) for the foreign-born appear to be ten times higher than those for native-born. However, the average annual age-adjusted death rate\* is twice as high in the foreign-born as in the native-born. (The rates are 32.5 and 15.2 per 100,000 for foreign-born males and females and 17.7 and 7.8 for native-born, respectively.) Discrepancies in the rates of native and foreign-born for each sex were statistically significant ( $P_s < 0.01$ ).

As shown in Figure 1, stomach cancer deaths were nil before 25 years of age for both males and females. There was no apparent difference in the average annual age-specific death rates for males and females in age groups 25-34 and 35-44. In the age group 45-54 and subsequent age groups, the rates were about twice as high in males as in females. In these age groups, there is a steep increase in the rates for both sexes. This pattern was also apparent in both the native-born and foreign-born groups, as shown in Figure 2.

*Place of Birth*—The foreign-born population of Manitoba is composed mainly of persons of British extraction followed by those from the USSR, Poland, Germany, and Scandinavia. Therefore one may expect that these countries

\* The 1961 Manitoba population was used as a standard population.

Figure 1—Average annual age-specific mortality from cancer of gastrointestinal tract by site and sex among Manitoba residents, 1956-1965



of birth are responsible for the excess deaths from stomach cancer among the foreign-born population.

In Table 2, the observed numbers of deaths and SMR's with 95 per cent confidence limits for countries of birth are given. From this table, one will note

that immigrants from Scandinavia, the USSR, and Poland, particularly, appear to have high risks of dying from stomach cancer as compared to immigrants from other countries, although all the foreign countries of birth, except the United States, showed increased risks.

It must be remembered that the majority of USSR immigrants in Manitoba are of Ukrainian origin. Thus, the

Ukrainian-born population may be considered as one of the largest risk groups. Among the Scandinavians, Icelandic

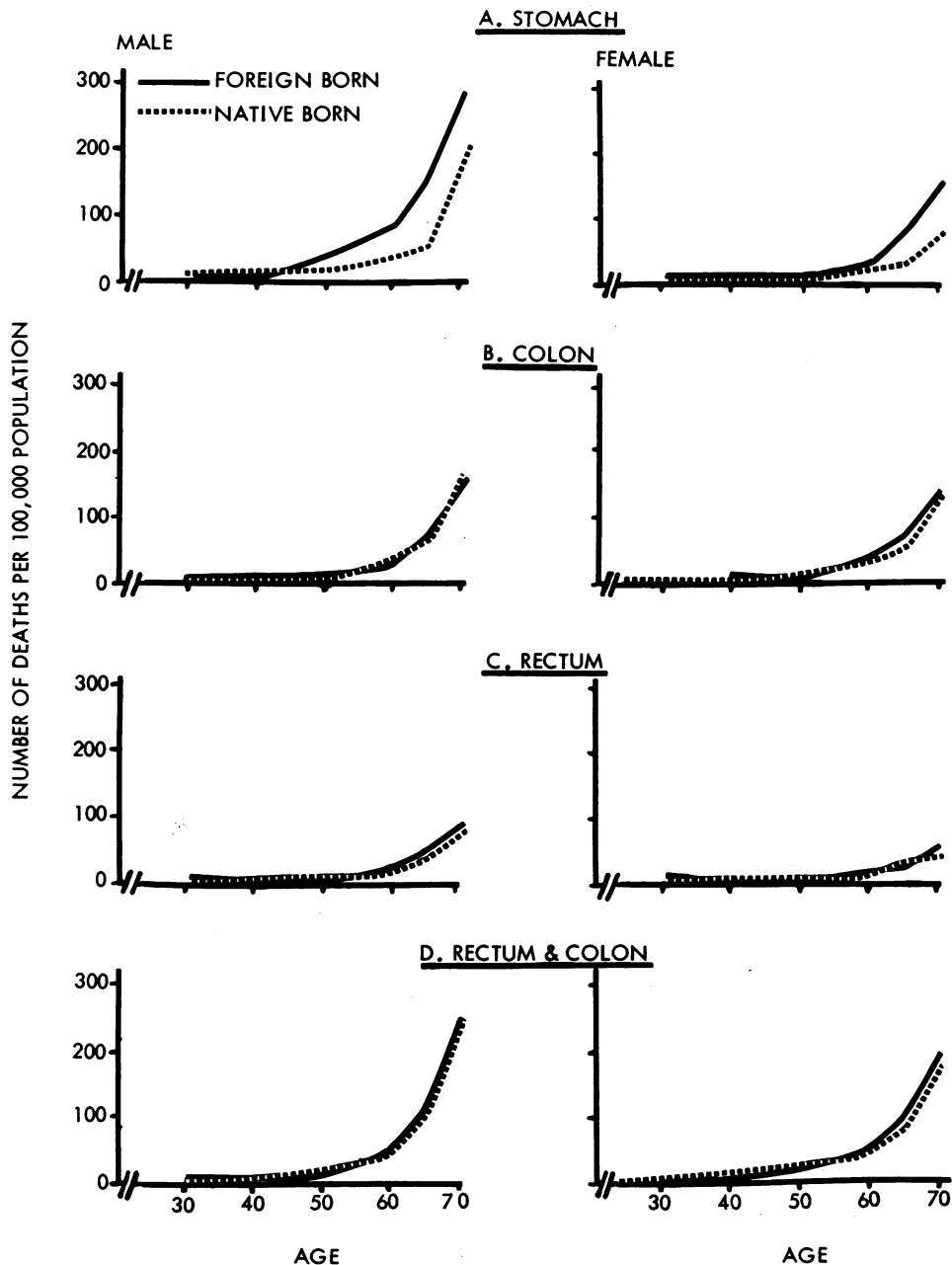


Figure 2—Average annual age-specific mortality from cancer of gastrointestinal tract by site and sex among native and foreign-born Manitobans, 1956-1965

**Table 2—Standardized Mortality Ratios,\* with numbers of deaths observed according to country of birth and sex for specific site of gastrointestinal cancer, foreign-born Manitoba residents, 1956-1965**

Country of birth	Stomach†			Colon			Rectum			Colon and rectum		
	Observed deaths	SMR	Observed deaths	SMR	Observed deaths	SMR	Observed deaths	SMR	Observed deaths	SMR		
British Isles	Male	283	134-151-170	205	109-125-144	126	134-160-191	331	122-136-152			
	Female	135	146-173-190	183	117-136-158	50	90-121-160	233	116-132-150			
England	Male	170	130-151-175	129	109-130-155	76	127-161-203	205	122-140-161			
	Female	75	130-164-207	102	105-129-157	35	101-145-202	137	111-133-145			
Scotland	Male	82	119-149-186	52	80-108-142	35	106-152-211	87	98-122-151			
	Female	44	133-182-244	59	109-142-185	9	32-70-133	68	98-125-159			
Ireland	Male	23	107-168-252	18	88-149-235	12	107-207-362	30	113-168-240			
	Female	9	69-150-285	19	110-183-285	4	35-127-325	23	108-170-255			
Wales	Male	5	44-135-315	5	50-154-359	3	39-190-554	8	72-166-327			
	Female	5	117-362-843	3	26-126-367	1	3-135-752	4	35-127-325			
Other	Male	3	29-142-415	1	1-54-300	0	0	1	1-36-200			
	Female	2	30-250-903	0	0	1	6-232-1292	1	1-54-300			
Scandinavia	Male	53	185-248-326	23	112-176-264	7	31-78-161	30	73-108-154			
	Female	21	175-282-431	12	49-94-165	1	1-26-145	13	41-78-133			
Denmark	Male	7	86-215-443	5	59-181-421	1	2-71-395	6	53-144-314			
	Female	0	0	1	1-86-479	0	0	1	2-65-362			
Norway	Male	7	68-170-350	4	31-113-289	3	36-175-511	7	53-133-273			
	Female	0	0	1	1-50-279	0	0	1	1-38-211			
Sweden	Male	16	105-184-298	7	39-97-199	2	7-58-209	9	39-85-162			
	Female	11	245-490-877	2	6-48-173	0	0	2	4-37-134			
Iceland	Male	23	248-391-587	7	54-134-276	1	1-41-228	8	45-104-205			
	Female	10	152-316-581	8	64-148-291	1	2-62-345	9	59-128-243			
Finland	Male	1	3-114-635	0	0	0	0	0	0			
	Female	0	0	0	0	0	0	0	0			
France	Male	13	127-239-409	2	5-41-148	3	27-132-385	5	23-70-163			
	Female	3	32-153-447	5	48-147-312	1	2-93-518	6	49-134-292			
Italy	Male	8	103-240-473	6	76-208-453	1	2-67-373	7	64-160-329			
	Female	3	69-337-984	4	68-250-640	0	0	4	51-188-481			
Netherlands	Male	9	105-230-437	3	20-95-277	1	1-59-328	4	22-82-210			
	Female	2	14-114-416	0	0	2	31-253-913	2	8-63-227			
Germany	Male	18	146-246-389	5	27-83-193	5	51-156-363	10	52-109-201			
	Female	3	19-92-269	5	28-85-198	3	32-156-455	8	44-102-200			

**Table 2—Part 2, Standardized Mortality Ratios,\* with numbers of deaths observed according to country of birth and sex for specific site of gastrointestinal cancer, foreign-born Manitoba residents, 1956-1965**

Country of birth	Stomach			Colon			Rectum			Colon and rectum		
	Observed deaths	SMR		Observed deaths	SMR		Observed deaths	SMR		Observed deaths	SMR	
USSR	Male 176	190-221-257		78	89-112-140		40	84-117-159		118	95-114-137	
	Female 93	241-297-366		61	87-113-147		31	122-180-257		92	104-129-158	
Poland	Male 93	169-208-257		20	32-53-82		15	43-77-127		35	43-61-85	
	Female 29	109-162-233		22	45-71-107		8	34-80-158		30	49-73-104	
Austria	Male 93	140-172-212		18	22-37-58		13	30-56-96		31	29-43-61	
	Female 30	110-163-233		22	44-70-106		13	70-131-224		35	59-85-118	
Czechoslovakia	Male 10	112-233-429		3	18-85-248		2	13-106-383		5	30-92-214	
	Female 4	84-310-794		1	1-44-245		1	3-133-741		2	8-66-238	
Hungary	Male 9	126-275-523		2	9-72-260		1	2-68-378		3	15-71-207	
	Female 2	19-157-567		3	28-137-400		1	4-140-779		4	38-138-353	
Rumania	Male 5	56-172-401		7	111-278-572		0	0		7	74-184-379	
	Female 2	21-174-628		2	12-101-364		1	4-154-857		3	23-114-333	
Other	Male 32	137-202-287		9	29-64-122		4	16-59-151		13	34-63-107	
Europe	Female 11	110-221-396		2	3-28-101		0	0		2	2-20-72	
Asia	Male 12	97-188-329		8	61-141-278		2	9-73-263		10	57-119-218	
	Female 2	31-260-938		0	0		1	6-222-1236		1	1-56-311	
United States	Male 26	61-94-138		15	34-62-102		10	40-84-154		25	45-69-102	
	Female 17	69-118-189		31	84-125-179		12	78-150-262		43	95-131-175	
Other	Male 0			5			8			13		
foreign†	Female 0			3			1			4		
Total	Male 839	167-179-209		409	91-100-109		238	104-119-135		647	98-106-115	
	Female 359	174-193-215		356	100-112-124		126	105-125-149		482	105-115-125	

\* SMR (adjusted for age by the indirect method) = 100 for native-born Manitobans.

† SMR's are shown in type, with their 95 per cent confidence limits in italics.

‡ Foreign-born with unknown country of birth.

and Swedish origins are of particular interest as they represent the majority of the Scandinavians in Manitoba. SMR's for these groups are particularly high; 391 and 316 for Iceland-born males and females; and 184 and 490 for Swedish-born males and females, respectively.

*Racial Origin*—In Table 3, the observed numbers of stomach cancer deaths by racial origin, regardless of birthplace, and corresponding SMR's with 95 per cent confidence limits, are shown. One may note that, in general, a pattern of discrepancies in SMR's computed for different racial origins similar to those among corresponding countries of birth was evident. However, the discrepancies noted among racial origins are not as marked as those among foreign-born population (as shown in Table 2), which appears to indicate some decrease of risk of dying from stomach cancer among descendants as compared to the ancestors who immigrated to Canada.

In order to estimate risks of dying from stomach cancer in descendants of immigrants from specific countries or groups of countries, observed numbers and expected numbers for the descendants were derived by subtracting relevant numbers for foreign-born groups from the relevant numbers for racial origin groups. The expected numbers of deaths for racial origin groups were computed based on age-specific rate for native-born population, as done for foreign-born groups, for this purpose. This attempt was made with the assumption, which may not be necessarily valid, that those who were born in a given specific foreign country before immigrating to Canada represent the same racial origin as the country of birth, and because there was no classification of racial origin specifically for the native-born population available in the census figures.

Except for the Poles and Russians, the above-mentioned assumption appears to be valid particularly for such groups

as those from the British Isles, Scandinavia, Germany, and other European countries. Relevant SMR's with 95 per cent confidence intervals are shown in Table 4A as a simpler form. In the instance of the Poles and Russians by country of birth, the deviation noted may be due to the proportion of non-Poles and non-Russians, ethnically, born in these respective countries.

The Standardized Mortality Ratios for Scandinavians are of particular interest. They demonstrate gradients, i.e., the ratio is highest for the foreign-born generations and the SMR for their descendants is intermediate between the foreign-born and total native-born SMR's. Inasmuch as the Icelandic component of Scandinavia seemed to be largely responsible for such an excess mortality among Scandinavian immigrants, similar estimates of SMR's were made for Icelandic descendants. As compared to the male SMR of 391 and female SMR of 316, for the Iceland-born, estimated SMR's for Icelandic descendants were 186 for males and 166 for females.

## 2. Colonic and Rectal Cancer

A total of 1,997 Manitobans were reported to have died of cancer of either the colon or rectum during the study years—the cancer listed as the primary or secondary cause of death. Of 1,997, 1,370 (701 males and 669 females) were attributed to colonic cancer and 627 (398 males and 229 females) were of rectal cancer. Average annual death rates per 100,000 population for colonic cancer were 15.0 and 14.8 for males and females respectively; 8.5 and 5.1 for rectal cancer. (Thus the rates for colon and rectum combined were 23.5 and 19.9).

Average annual age-adjusted death rates for colonic cancer are 15.0 and 15.2 per 100,000 for foreign-born males and females, and 15.0 and 13.9 for native-born; and 8.9 and 5.2 for foreign-born and 7.7 and 4.5 for native-born for rectal cancer, respectively. Corre-



Table 3—Standardized Mortality Ratios,\* with numbers of deaths observed according to racial origin† and sex for specific site of gastrointestinal cancer, Manitoba residents, 1956-1965

Racial origin	Stomach			Colon			Rectum			Colon and rectum		
	Observed deaths	SMR†		Observed deaths	SMR		Observed deaths	SMR		Observed deaths	SMR	
British Isles	Male	72-79-86	434	109-120-132	251	107-123-139	685	112-121-131				
	Female	71-82-93	415	103-114-126	121	81-97-116	536	101-110-120				
English	Male	59-67-76	213	85-98-112	116	79-95-112	329	87-97-108				
	Female	59-71-85	198	78-90-104	69	72-92-114	267	80-91-103				
Scottish	Male	74-87-103	136	113-134-161	80	112-140-175	216	119-136-156				
	Female	73-92-116	137	110-131-157	29	54-81-117	166	102-119-139				
Irish	Male	147-184-230	72	218-277-351	47	236-322-429	119	244-293-352				
	Female	113-164-231	73	229-290-367	22	161-256-387	95	228-282-349				
Welsh	Male	28-62-122	13	90-169-289	7	65-162-334	20	101-166-256				
	Female	18-66-169	5	22-67-156	1	1-39-217	6	22-60-131				
Others	Male	1-11-40	0	0	1	1-17-95	1	1-6-33				
	Female	1-15-84	2	3-25-90	0	0	2	2-19-69				
Scandinavia	Male	119-149-186	29	61-91-131	10	26-55-101	39	54-78-108				
	Female	94-138-195	29	66-99-143	7	28-70-144	36	63-91-126				
Danish	Male	64-140-266	6	60-163-355	1	1-47-262	7	48-120-247				
	Female	0	1	11-42-234	1	1-123-685	2	8-63-227				
Norwegian	Male	67-126-215	4	18-67-172	3	18-88-257	7	30-74-152				
	Female	26-95-243	3	11-55-161	3	69-337-984	6	35-95-207				
Swedish	Male	77-124-190	8	35-81-160	2	4-36-130	10	31-65-120				
	Female	90-180-322	9	53-116-220	0	0	9	39-86-163				
Icelandic	Male	128-183-253	11	44-89-159	4	16-57-146	15	43-77-127				
	Female	90-154-246	16	67-117-190	3	13-64-187	19	62-103-161				
French	Male	84-105-131	37	59-83-114	23	57-90-135	60	60-86-111				
	Female	58-86-124	42	69-97-132	11	40-74-132	53	68-91-119				
German	Male	67-86-108	36	56-80-111	16	35-61-99	52	55-73-96				
	Female	77-108-147	27	36-55-80	13	41-77-132	40	44-61-83				
Italian	Male	59-138-272	6	65-178-388	1	1-51-284	7	53-131-270				
	Female	95-294-685	5	71-219-510	0	0	5	53-163-379				
Finnish	Male	18-150-542	0	0	1	1-227-1264	1	1-85-473				
	Female	0	0	0	0	0	0	0				
Dutch	Male	89-124-164	14	39-72-121	13	60-113-193	27	57-87-127				
	Female	84-186-208	19	57-94-147	12	89-173-303	31	77-114-162				

Table 3—Part 2, Standardized Mortality Ratios,\* with numbers of deaths observed according to racial origin† and sex for specific site of gastrointestinal cancer, Manitoba residents, 1956-1965

Racial origin	Stomach			Colon		Rectum		Colon and rectum	
	Observed deaths	SMR‡	Observed deaths	SMR	Observed deaths	SMR	Observed deaths	SMR	
USSR	234	132-149-168	70	60-77-98	42	57-80-109	112	66-78-94	
	81	117-144-180	57	59-78-102	32	87-128-179	89	74-91-113	
Russian	14	64-117-197	9	60-130-247	1	1-25-139	10	44-92-169	
	3	15-74-216	4	21-77-197	1	1-56-319	5	23-72-168	
Ukrainian	220	131-151-174	61	56-72-94	41	61-85-116	102	63-77-94	
	78	119-149-187	53	59-79-103	31	90-134-189	84	75-93-116	
Polish	80	111-139-174	17	30-52-83	15	44-79-130	32	42-62-88	
	28	84-126-183	24	53-83-124	8	35-81-160	32	56-83-118	
Austrian	11	25-50-90	4	8-30-77	5	22-68-158	9	20-44-84	
	4	14-51-131	5	17-52-121	6	66-180-392	11	42-84-150	
Czechoslovakian	10	83-173-318	4	34-125-320	0	1-53-295	5	32-98-228	
	4	63-231-591	3	27-131-382	0	0	3	23-110-321	
Hungarian	10	99-207-381	2	9-73-264	2	15-123-444	4	25-92-236	
	2	15-120-433	3	29-136-397	0	0	3	21-101-295	
Rumanian	2	9-74-267	0	0	0	0	0	0	
	0	0	1	29-114-635	0	0	1	1-85-473	
Other European	28	88-133-193	7	24-60-123	4	17-61-156	11	30-60-107	
	8	52-120-236	7	32-81-166	0	0	7	24-59-121	
Asiatic	12	63-121-212	8	58-134-264	0	0	10	52-108-199	
	2	21-175-632	0	0	1	74-61-220	1	1-50-278	
Eskimo and Native	4	6-22-56	1	1-10-58	1	1-192-1063	2	2-12-43	
Indian	6	29-80-174	4	11-42-108	3	1-17-95	7	22-54-111	
Jewish	33	86-125-176	29	123-183-263	8	38-88-173	37	105-149-204	
	25	111-172-255	25	87-135-199	12	98-190-333	37	105-149-204	
Other	6	30-81-177	3	14-69-201	3	25-121-353	6	32-88-192	
	1	1-27-150	3	13-64-187	3	39-189-552	6	35-96-209	
Total	1,198	100	701	100	398	100	1,099	100	
	529	100	669	100	229	100	898	100	

\* SMR (adjusted for age by the indirect method) = 100 for total Manitobans.

† Racial origin is so defined in terms of the people or race traced through father to which the person belongs, e.g., English, Irish, Scottish, French, Ukrainian, and so on.

‡ SMR's are shown in type, with their 95 per cent confidence limits in italics.

sponding figures for colon and rectum combined are 23.9 and 20.3 for foreign-born and 22.7 and 18.4 for native-born. Discrepancies in the rates between foreign-born and native-born for each sex were not statistically significant for cancer of the colon alone, although for the females, the excess mortality from rectal and colonic cancer combined was statistically significant ( $P < 0.01$ ).

As shown in Figure 1, colonic cancer deaths were almost nil before 25 years of age and the rates are gradually increasing following the age group 35-44. Before the 65-69 age group, there was a slight excess of deaths in females while the pattern is reversed in the age groups of 65-69 and 70 and over. On the other hand, the rates for rectal cancer reveal slight excesses in males over females throughout the age groups. The pattern for rectum and colon combined was similar to that of colonic cancer alone, although male excess deaths started to show up in the age groups 55-64. These patterns prevail both among native-born and foreign-born as shown in Figure 2, whereas slight excess deaths were noted among foreign-born, age groups 55-64 and over.

*Place of Birth*—Except for the British Isles, none of the groups of countries of birth showed significant excess or deficit deaths from colonic cancer, rectal cancer or colonic and rectal cancer combined (Table 2). Excess deaths from such cancers for the British Isles were largely attributed to England and they in turn appear to be responsible for certain excess deaths from the cancers in the foreign-born. The significant excess deaths from rectal cancer and rectal and colonic cancer combined among USSR-born females were also noted. Also borderline significance of the excess deaths from colonic and rectal cancer combined in the United States-born females is worthy of note.

*Racial Origin*—As in the case of birth-place, except for the British Isles racial

origin, no significant difference in such cancer deaths was noted among the various racial origin groups.

Risks of dying from such cancer do not appear to differ between immigrants and their descendants of British Isles extraction, although the slightly decreasing risks in the descendants may be apparent as seen from Table 4B. Of some interest is the noted increase of SMR's among the descendants from Eastern Europe. One may note the facts that SMR's of such cancer deaths for "other Europe" and most of the Eastern European-borns are within the expected figures as shown in Table 2, whereas such SMR's for Eastern European descendants are higher than the expected (Table 4B). Therefore one may conclude that this heterogeneous group collectively shows the increased risks among their descendants.

## Discussion

The reported age-adjusted death rates for stomach cancer, 1960-1961 among the 24 countries studied by Segi, et al.,<sup>3</sup> rank Canada as the twenty-second both for males and females, whereas it was second for both sexes for large intestinal cancer, except rectum, and twelfth and ninth for rectal cancer of males and females respectively in that order. The colonic cancer rates for United States whites were approximately the same as those for Canadians.

In our analyses of mortality data as to these sites, a statistically significant excess mortality for stomach cancer among foreign-born Manitobans as compared to native-born was noted, whereas there were no marked differences of rates for the colonic and rectal cancer between the foreign-born and native-born.

The pattern observed appears to be consistent, in general, with the report by Segi, et al.<sup>3</sup> and agrees with similar mortality studies by Haenszel<sup>4</sup> in 35 states of the United States and by Newill<sup>5</sup> in New York City, and also with

**Table 4A—Standardized Mortality Ratios with numbers of deaths according to ethnic origin by foreign born and native born by sex, Manitoba residents, 1956-1965**

		Stomach Cancer			
Ethnic origin		Foreign born		Native born	
		Observed deaths	SMR	Observed deaths	SMR
British Isles	Male	283	134-151-170	201	73- 84-97
	Female	135	146-173-190	104	73- 89-108
Scandinavia	Male	53	185-248-326	29	119-178-256
	Female	21	175-282-431	11	67-135-242
Danish	Male	7	86-215-443	2	21-172-621
	Female	0	0	0	0
Norwegian	Male	7	68-170-350	6	72-195-425
	Female	0	0	4	64-235-602
Swedish	Male	16	105-184-298	5	47-145-338
	Female	11	245-490-877	0	0
Icelandic	Male	23	248-391-587	16	106-186-301
	Female	10	152-316-581	7	66-166-342
Dutch	Male	9	105-230-437	34	118-171-239
	Female	2	14-114-416	19	128-213-332
French	Male	13	127-239-409	67	111-142-182
	Female	3	32-153-447	26	81-124-182
Eastern European	Male	406	173-191-211	38	98-139-190
	Female	150	160-188-221	19	92-152-237
Jewish	Male	30	128-190-272	3	19- 94-215
	Female	24	188-293-437	1	2- 60-334

some morbidity studies, one by Graham, et al.<sup>6</sup> and the other by Kurland and his associates.<sup>7</sup> The last-named morbidity study dealt with the total community of Rochester, Minn. Virtually all cases of stomach cancer for the last three decades were ascertained and verified by utilizing the existing record retrieval system in the Mayo Clinic and other institutions in Rochester. The morbidity study by Graham, et al., utilized accumulated cases of cancer of the various sites, including stomach and large intestines, admitted to Roswell Park Memorial Institute, Buffalo, N. Y.

The preliminary tabulation from the Rochester study indicates that excess mortality from stomach cancer among the foreign-born population appears to be more noticeable in the first decade of the study period (1935-1964) and diminishes in the following decades. It

may be of some significance that the decreasing trend of incidence appears to have occurred in parallel, both among native and foreign-born population. The current mortality study period corresponds approximately to the last decade of the Rochester study. Nevertheless, a risk twice as high was noted in the foreign-born as compared to the native-born in the current study. This may be because of the fact that the Manitoban foreign-born population may consist of more recent immigrants than the Rochester population. Environmental factors or host habits, if any, peculiar to those foreign-born inhabitants before their immigration to Canada may still prevail in the population, whereas they may be fading away in the Rochester population. It is also possible that the mean age of the immigrants in Manitoba at migration may have been higher than

that of the foreign-born population who, during the recent decades, have lived in Rochester and the surrounding areas. Accordingly, Manitoban immigrants already had been exposed to noxious agents before the migration or their host habits might not have changed even after migrating to new lands, in contrast to what might have been the case in Minnesota. Without studying the trends of migration to these two North American communities, one cannot validate either hypothesis. Nevertheless, it may appear to be a plausible hypothesis and is worthy of further exploration.

The apparent decreasing trend noted from the Rochester morbidity study<sup>7</sup> and mortality studies,<sup>3,8-10</sup> may suggest changes of environment and/or host habits, among other things, which would

contribute to the differential incidences of cancer. In the current study, immigrants from Scandinavia, particularly Iceland, the USSR particularly the Ukraine, and Poland revealed higher risks than among their descendants. This may be another indication that the downward trends of incidence as well as mortality in some of the countries, provinces, and communities may be the reflection of a gradual diminution of the high-risk groups in such populations. Changes among the descendants, from "noxious" environments to less "noxious" environments or of host habits which prevailed among their ancestors, if any, may also have contributed to such a downward trend, as well as decreased risk among the descendants noted in our study. This of course en-

**Table 4B—Standardized Mortality Ratios with numbers of deaths according to ethnic origin by foreign born and native born by sex, Manitoba residents, 1956-1965**

Colonic and Rectal Cancer Combined

Ethnic origin		Foreign born		Native born	
		Observed deaths	SMR	Observed deaths	SMR
British Isles	Male	331	122-136-152	353	104-116-128
	Female	233	116-132-150	301	97-109-122
Scandinavia	Male	30	73-108-154	9	20- 44-84
	Female	13	41- 78-133	23	74-116-174
Danish	Male	6	53-144-314	1	2- 69-384
	Female	1	2- 65-362	1	2- 69-384
Norwegian	Male	7	53-133-273	0	0
	Female	1	1- 38-211	5	39-120-280
Swedish	Male	9	39- 85-162	1	1- 24-134
	Female	2	4- 37-134	7	66-164-338
Icelandic	Male	8	45-104-205	7	25- 63-130
	Female	9	59-128-243	10	48-100-184
Dutch	Male	4	22- 82-210	23	56- 88-132
	Female	2	8- 63-227	29	86-129-186
French	Male	5	23- 70-163	55	69- 91-119
	Female	6	49-134-292	47	69- 94-125
Eastern European	Male	186	58- 67-78	40	94-131-178
	Female	140	66- 78-92	48	90-122-163
Jewish	Male	36	123-175-242	1	1- 28-156
	Female	36	136-194-268	1	1- 22-123

hances the theory of environmental and/or host habits in the production of stomach cancer, rather than genetic factors, and this in turn may explain the observed diverse distribution of the cancer among countries and subgroups of the population. The findings from the studies on cancer mortality among Japanese Issei and Nisei of California<sup>11</sup> and of British Columbia<sup>12</sup> also are consistent with this theory.

Evidence from the study in Iceland<sup>13</sup> suggests that 3,4 benzopyrene in smoked and singed food, which are common items consumed in Iceland, may have been contributing to a higher incidence of stomach cancer in the country and possibly to Icelanders in Manitoba. It would be highly desirable to study dietary habits among the immigrants from Iceland and their descendants in Manitoba, which in turn could be compared with the Icelandic population in Iceland.

This kind of investigation bears on changes in dietary habits, both in remaining family members in Iceland and immigrants to Canada and their descendants, as related to incidence of stomach cancer.

Without knowing the accuracy of diagnoses of cancer of the large intestine as they appear on death certificates, interpretation of the patterns noted for the individual sites, i.e., colon and rectum, would be contingent on their validity. For rectum and colon, either separately or combined, there were no marked differences in the risk of dying according to nativity. However, there was a tendency of increased risk among the foreign-born at 55-64 and the older age groups, particularly for females for rectal and colonic cancer combined (Figure 2). This tendency may be of some importance if one considers the fact that the reported mortality from such cancer in Canada was unusually high, as compared to other countries.<sup>3</sup> One must remember that for none of the groups of countries of birth, except for the British

Isles, the rates surpassed the rates for native-born Manitobans (Table 2). This pattern roughly corresponds to the reported rates for 24 countries by Segi, et al.,<sup>3</sup> which for the intestinal cancer (except rectum) indicated that only the Scottish rates surpassed those for the Canadian, English, Welsh, and Irish, which were close to the Canadian.

Unlike the situation in stomach cancer, the risk of intestinal cancer among descendants of certain European ethnic groups, i.e., Eastern Europe (Table 4B), appears to be greater than for the immigrants. This heterogeneous group happens to represent those countries showing considerably lower rates reported by Segi, et al.<sup>3</sup> This might suggest that some environmental factors or host habits which were not common in their homelands or among their ancestors may be responsible for the noted upward gradient among their descendants. It is noteworthy that Wynder and other conferees reviewed some contrasting epidemiologic features between gastric and colonic cancer.<sup>14</sup> The implication, according to the present study along with the previous communications, is that environmental factors as well as host habits, particularly the dietary, rather than genetic factor or factors, may be affecting the gastrointestinal cancers, but in different modes for specific sites of the tract. Comprehensive case-history studies as related to host habits and environments among different ethnic groups are definitely in order.

### Summary and Conclusions

A study was carried out on 1,727 stomach cancer deaths and 1,997 deaths for colonic and rectal cancer among Manitoba residents occurring during 1956-1965, inclusive. Particular emphasis was made on population selectivity of such cancers by ethnic characteristics. The following are some of the significant findings and their implications:

1. Foreign-born Manitobans appear to have had a higher risk of dying from

stomach cancer, while there were no marked differences in mortality either for colonic or rectal cancer according to nativity.

2. Immigrants from Scandinavia (particularly Iceland), the USSR (the majority are Ukrainians) and Poland appear to be the high-risk groups for stomach cancer.

3. There appears to be a gradient showing the highest risk of stomach cancer mortality among the foreign-born, particularly of the above-mentioned, an intermediate risk among their descendants, and the lowest risk among native-born Manitobans as a whole.

4. On the contrary, there appears to be an altered gradient particularly among certain groups from Eastern European countries in the risk of dying from colonic and rectal cancer, namely, the lowest risk is among their immigrant generations, an intermediate risk among native-born Manitobans as a whole, and the highest risk among the descendants of the immigrants.

5. The findings emphasize differential epidemiologic features between stomach cancer and cancer of the large intestine.

6. The findings suggest the importance of environmental factors and host habits, e.g., dietary and so on, in the production of cancer of the intestines as well as stomach, rather than a genetic factor.

7. Thus it seems apparent that in the future study of cancer particular emphasis must be placed on host habits, including dietary habits among immigrants, e.g., Icelandic and other Scandinavians, and their descendants in Manitoba, and those remaining in their homeland.

**ACKNOWLEDGMENT**—The author wishes to express his appreciation for the significant contributions of the following: the Vital Statistics Section of the province of Manitoba for providing the death certification information; Mr. A. Nicoll, University of Manitoba Computer Centre, for his assistance in programming for the cross-tabulations; Mr. Paul Ma, statistical assistant, Department of Social and Preventive Medicine, for his assistance in computation, and many other staff members in the Department of Social and Preventive Medicine for assistance in compilation of relevant data.

## REFERENCES

1. Choi, N. W. Comparability of Diagnoses of Cancer on Death Certificates and Reports to Cancer Registry. In preparation.
2. Haenszel, W.; Loveland, D. R.; and Sirken, M. G. Lung-Cancer Mortality as Related to Residence and Smoking Histories. I. White Males. *J. Nat. Cancer Inst.* 28:947-1001, 1962.
3. Segi, M., and Kurihara, M. Cancer Mortality for Selected Sites in 24 Countries, No. 3 (1960-1961). Sendai, Japan, Tohoku University Medical School.
4. Haenszel, W. Cancer Mortality Among the Foreign-Born in the United States. *J. Nat. Cancer Inst.* 26: 37-132, 1961.
5. Newill, V. A. Distribution of Cancer Mortality Among Ethnic Subgroups of the White Population of New York City, 1953-58. *Ibid.* 26:405-417, 1961.
6. Graham, S.; Levin, M. L.; Lillienfeld, A. M.; and Sheehe, P. Ethnic Derivation As Related to Cancer at Various Sites. *Cancer* 16:13-27, 1963.
7. Kurland, L. T. Unpublished communication.
8. Sigurjonsson, J. Trends in Mortality from Cancer, with Special Reference to Gastric Cancer in Iceland. *J. Nat. Cancer Inst.* 36:899-907, 1966.
9. Haenszel, W. Variation in Incidence of and Mortality from Stomach Cancer with Particular Reference to the United States. *Ibid.* 21:213-262.
10. Phillips, A. J. Cancer Mortality Trends in Canada—1944-1963. *Canad. M. A. J.* 93:63-67, 1963.
11. Buell, P., and Dunn, J. E., Jr. Cancer Mortality Among Japanese Issei and Nisei of California. *Cancer* 18:656-664, 1965.
12. MacDonald, W. C. Gastric Cancer Among the Japanese of British Columbia: Dietary Studies. In: Proceedings of the Sixth Canadian Cancer Research Conference, Honey Harbour, Ont., 1964, edited by R. W. Begg. Pergamon Press, London, 1966, p. 451.
13. Dungal, N., and Sigurjonsson, J. Gastric Cancer and Diet. A Pilot Study on Dietary Habits in Two Districts Differing Markedly in Respect of Mortality from Gastric Cancer. *Brit. J. Cancer* 21:270-276, 1967.
14. Conference on the Etiology of Cancer of the Gastrointestinal Tract. Report of the Research Committee (World Health Organization) on Gastroenterology. New York, N. Y., June 10-11, 1965. *Cancer* 19:1561-1566, 1966.

Dr. Choi is Associate Professor, Department of Social and Preventive Medicine, University of Manitoba (750 Bannatyne Ave.), Winnipeg 3, Manitoba, Canada.

This paper was presented before the Epidemiology Section of the American Public Health Association at the Ninety-Fifth Annual Meeting in Miami Beach, Fla., October 24, 1967.

This study was supported by the National Cancer Institute of Canada Research Grant and the Canadian National Health Research Grant No. 606-7-137.