Avoidable Mortality for Causes Amenable to Medical Care, by Occupation in Canada, 1991-2001

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ABSTRACT

Objective: To describe the incidence of avoidable mortality for causes amenable to medical care among occupation groups in Canada.

Method: A cohort study over an 11-year period among a representative 15% sample of the non-institutionalized population of Canada aged 30-69 at cohort inception. Age-standardized mortality rates for causes amenable to medical care and all other causes of death were calculated for occupationally-active men and women in five categories of skill level and 80 specific occupational groups as well as for persons not occupationally active.

Results: Age-standardized mortality rates per 100,000 person-years at risk for causes amenable to medical care and for all other causes were 132.3 and 218.6, respectively, for occupationally-active women, and 216.6 and 449.3 for occupationally-active men. For causes amenable to medical care and for all other causes, for both sexes, there was a gradient in mortality relative to the five-level ranking by occupational skill level, but the gradient was less strong for women than for men. Across the 80 occupation minor groups, for both men and women, there was a linear relationship between the rates for causes amenable to medical care and the rates for all other causes.

Conclusions: For occupationally-active adults, this study found similar gradients in mortality for causes amenable to medical care and for all other causes of mortality over the period 1991-2001. Avoidable mortality is a valuable indicator of population health, providing information on outcomes pertinent to the organization and delivery of health care services.

Key words: Occupations; cause of death; health services research

La traduction du résumé se trouve à la fin de l'article.

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The specific contribution of health care in reducing socio-economic health inequalities continues to be an important policy focus in the funding, organization and delivery of health care in Canada. Arising from this policy focus, the monitoring of socio-economic equity in access to health services and the quality of health services is an important research priority.[1-5]

The concept of avoidable mortality has been applied in mortality surveillance studies to identify geographic or temporal differences in cause-specific mortality which is amenable to primary or secondary prevention.[2,6-13] When the definition of avoidable mortality is restricted to those causes of death which can be prevented by timely access to medical care, approximately 30% of population mortality is defined as avoidable and this proportion is higher in working-age adults.[13]

Relatively few studies have reported on socio-economic differences in avoidable mortality. A recent report examined changes in avoidable mortality in urban Canada over the 25-year period 1971-1996 following the introduction of universal health insurance for medically necessary services.[2] For deaths before age 75, differences between the richest and poorest 20% of the urban population in age-standardized expected years of life lost due to deaths amenable to medical care decreased 60% for men and 78% for women. The decrease in income-related disparities due to non-amenable causes was much smaller (15% for men and 9% for women).

The surveillance and monitoring of population health trends in most countries includes the use of large, nationally-representative population-based cohort studies of mortality, usually formed by linking records for national census respondents to vital statistics death registrations.[14-18] Until recently, no nationally-representative census-based cohort had been established in Canada. To address this limitation, Statistics Canada, the Institute for Work & Health and the Direction de la Santé Publique de Montréal-Centre collaborated in the creation of a database (the 1991-2001 Canadian census mortality follow-up study) linking a 15% sample of 1991 census respondents to the Canadian Mortality Data Base.[1]

The objective of this study was to examine differences in the incidence of avoidable mortality for causes amenable to medical care among occupationally-active adults in Canada aged 30-69 by occupation and skill level as well as for persons who were not occupationally active. Occupation and skill level were used to estimate socio-economic differences in mortality amenable to medical care.

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Table 1. Avoidable Mortality for Causes Amenable to Medical Care and for All Other Causes, by Occupational Skill Level, Non-institutionalized Persons Aged 30-69 at Cohort Inception, Canada, 1991-2001

	Occupational Skill Level	Number of Deaths	Person-years at Risk	Crude Mortality Rate	ASMR	95% Confidence Interval	SRR	95% Confidence Interval
Women	Causes amenable to medical care							
	Professional	987	1,395,200	70.7	108.3	99.1-118.3	**0.82**	**0.75-0.89**
	Managerial	529	585,420	90.4	140.1	125.2-156.7	1.06	0.95-1.18
	Skilled/Technical/Supervisory	2025	2,222,070	91.1	129.8	123.2-136.8	0.98	0.94-1.03
	Semi-skilled	2981	3,040,850	98.0	135.2	129.4-141.3	1.02	0.99-1.06
	Unskilled	1073	860,830	124.6	151.2	140.7-162.5	**1.14**	**1.07-1.22**
	No occupation	8637	2,679,240	322.4	223.9	218.5-229.5	**1.69**	**1.63-1.76**
	All occupations (reference)	7595	8,104,380	93.7	132.3	128.7-136.1	1.00	
	All other causes of death							
	Professional	1364	1,395,200	97.8	176.4	162.8-191.1	**0.81**	**0.75-0.87**
	Managerial	751	585,420	128.3	211.0	191.7-232.3	0.96	0.88-1.06
	Skilled/Technical/Supervisory	3137	2,222,060	141.2	217.7	208.6-227.1	1.00	0.96-1.03
	Semi-skilled	4491	3,040,850	147.7	222.9	214.8-231.3	1.02	0.99-1.05
	Unskilled	1661	860,830	193.0	261.0	245.9-277.1	**1.19**	**1.13-1.26**
	No occupation	15,725	2,679,240	586.9	363.5	356.7-370.3	**1.66**	**1.61-1.71**
	All occupations (reference)	11,404	8,104,380	140.7	218.6	213.6-223.8	1.00	
Men	Causes amenable to medical care							
	Professional	1385	1,286,350	107.7	158.7	149.5-168.5	**0.73**	**0.69-0.78**
	Managerial	1989	1,482,000	134.1	178.9	169.9-188.4	**0.83**	**0.79-0.87**
	Skilled/Technical/Supervisory	5501	3,377,130	162.9	213.9	207.6-220.4	0.99	0.97-1.01
	Semi-skilled	4665	2,517,960	185.3	248.0	239.8-256.4	**1.14**	**1.11-1.18**
	Unskilled	2335	937,920	249.0	270.4	258.9-282.4	**1.25**	**1.20-1.30**
	No occupation	11,663	1,235,860	943.7	544.2	528.7-560.2	**2.51**	**2.43-2.60**
	All occupations (reference)	15,875	9,602,360	165.3	216.6	212.8-220.4	1.00	
	All other causes of death							
	Professional	2938	1,286,350	228.4	343.0	328.9-357.6	**0.76**	**0.73-0.79**
	Managerial	4020	1,483,000	271.1	386.8	372.6-401.5	**0.86**	**0.83-0.89**
	Skilled/Technical/Supervisory	11,197	3,377,130	331.6	444.3	434.9-453.8	0.99	0.97-1.01
	Semi-skilled	9124	2,517,960	362.4	500.0	487.8-512.5	**1.11**	**1.09-1.14**
	Unskilled	4548	937,920	484.9	557.0	539.7-574.9	**1.24**	**1.20-1.28**
	No occupation	22,694	1,235,860	1836.3	972.6	951-994.6	**2.16**	**2.11-2.22**
	All occupations (reference)	31,827	9,602,360	331.4	449.3	443.6-455	1.00	

ASMR: Age-standardized mortality rate, SRR: Standardized rate ratio. Bold font in SRR column indicates statistically significant ($p<0.05$) compared to the reference group.

METHODS

Study design

The study is based on a cohort consisting of a 15% sample of the non-institutionalized population of Canada aged 25 years and over at the time of cohort inception in 1991 who were followed for mortality until the end of 2001.

Study population and study sample

The Canadian census mortality follow-up study was designed to be representative of the non-institutional population of Canada in 1991.[1] Cohort members were selected from among the approximately 20% of households who completed the "long-form" census questionnaire in 1991. Records for long-form census respondents were linked to mortality records to ascertain date and cause of death over the follow-up period from June 1, 1991 to December 31, 2001. A description of the record linkage procedure is provided elsewhere.[1] For the specific purpose of this study – reporting on occupational differences in mortality amenable to medical care – the study sample was restricted to individuals aged 30 to 69 at baseline, representing 1,704,100 persons who were occupationally active (929,300 men and 774,800 women), and 397,500 who were not occupationally active (133,100 men and 264,300 women) in the year preceding the census. Occupationally-active individuals were defined as persons who had worked any time in the year prior to the census.

Measures

In this report, we estimate the relationship between avoidable mortality and occupation, where occupation was classified to the 80 minor group categories of the 1980 Standard Occupational Classification and five ordinally-ranked occupational skill categories based on the 1990 National Occupational Classification.[19,20]

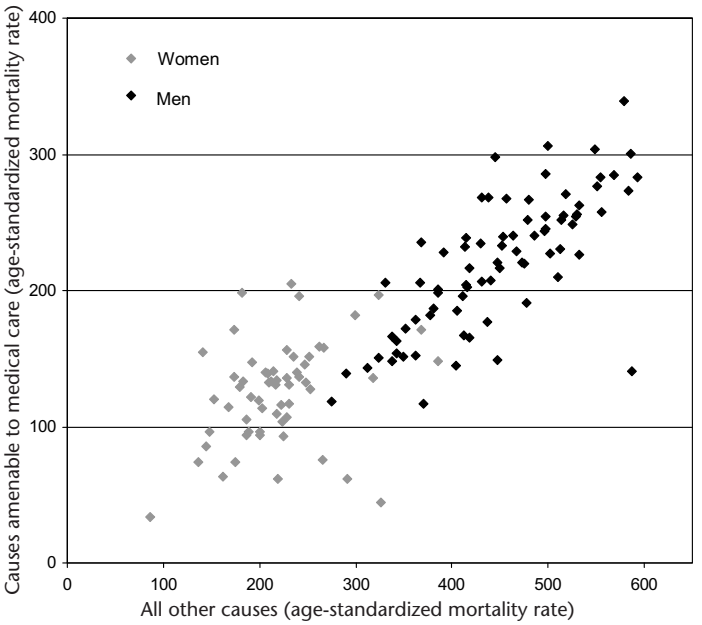
Causes of mortality amenable to medical care are those where timely access to medical care may prevent death (Appendix A).[2,6-11,21,22] For persons dying during the study period, the underlying cause of death had been previously coded to the World Health Organization's *International Classification of Diseases, Ninth Revision* (ICD-9)[23] for deaths occurring in the period 1991 through 1999, and to the *Tenth Revision* (ICD-10)[24] for deaths occurring in 2000 or 2001. For persons aged 65-69 at the time of cohort inception, any deaths occurring at ages 75 or older were classified as not amenable to medical care.

Statistical analysis

For each member of the cohort, we calculated person-days of follow-up from the beginning of the study (census day – June 4, 1991) to the date of death, emigration (ascertained from the name file and known for 1991 only), or end of the study (December 31, 2001). Person-days of follow-up were then divided by 365.25 to estimate person-years at risk.

Age-standardized mortality rates were calculated using the direct method, with the 1991 mid-year population estimates used as the

Figure 1. Age-standardized mortality rates for causes of death amenable to medical care and for all other causes, by minor occupation group, non-institutionalized men and women aged 30-69 at cohort inception, Canada, 1991-2001



Note: Occupation minor groups according to 1980 Standard Occupational Classification

standard population. Standardized rate ratios (SRR) were calculated from the age-standardized mortality rates and 95% confidence intervals for the SRRs were estimated. In addition, we calculated simple ratios of the age-standardized avoidable-cause mortality rate to the age-standardized non-avoidable-cause mortality rate to detect differences in the proportion of all deaths due to avoidable causes. Results for occupational groups in which fewer than three deaths were observed over the follow-up period were suppressed as required by data release protocols. We incorporated a covariance adjustment in the calculation of confidence intervals that accounts for the comparison of subgroups nested within the reference population. No adjustment for multiple comparisons was performed in the estimates of confidence intervals.[25]

The Canadian census mortality follow-up study was approved by the Statistics Canada Policy Committee after consultations with the Statistics Canada Confidentiality and Legislation Committee, the Data Access and Control Services Division, and the Federal Privacy Commissioner. The protocol for this research was reviewed and approved by the Health Sciences I Research Ethics Board of the University of Toronto.

RESULTS

Of the 43,361 deaths observed over the 11-year follow-up among women aged 30-69 at baseline, 37% were attributed to causes amenable to medical care. Of the 82,059 deaths observed among men, 34% were attributed to such causes (Table 1).

Among occupationally-active women, there was a gradient in mortality rates for causes of death amenable to medical care and all other causes relative to the five-level ranking by occupational skill level. For women in professional occupations, the age-standardized mortality rate for causes amenable to medical care and for all other causes was lower than the age-standardized rates observed for all occupationally-active women. For women in unskilled occupations, the age-standardized mortality rate for causes of death amenable to medical care and for all other causes were higher than the age-standardized rates observed for all occupationally-active women. For women across the five occupational skill levels, ratios of mortality rates for causes amenable to medical care to all other cause mortality rates were generally similar: 0.61 for professional occupations, 0.66 for managerial occupations, 0.60 for skilled, technical and supervisory occupations, 0.61 for semi-skilled occupations and 0.58 for unskilled occupations.

Among occupationally-active men, there was a stronger gradient both for causes amenable to medical care and for all other causes relative to the five-level ranking by occupational skill level. For men in professional and managerial occupations, the age-standardized mortality rate for causes amenable to medical care and for all other causes was lower than the age-standardized rates observed for all occupationally-active men. For men in semi-skilled and unskilled occupations, the age-standardized mortality rate for causes amenable to medical care and for all other causes was higher than the age-standardized rates observed for all occupationally-active men. For men across the five occupational skill levels, ratios of mortality rates for causes amenable to medical care to all other cause mortality rates were generally similar: 0.46 for professional occupations, 0.46 for managerial occupations, 0.48 for skilled, technical and supervisory occupations, 0.50 for semi-skilled occupations and 0.49 for unskilled occupations.

Men and women who were not occupationally active at the time of cohort inception had elevated age-standardized mortality rates both for causes amenable to medical care and for all other causes of death.

For occupationally-active women and men classified to the 80 minor group categories of the 1980 Standard Occupational Classification, Figure 1 depicts the correlation of age-standardized mortality rates for causes amenable to medical care compared to all other causes. Details are provided in Appendix B (for women) and Appendix C (for men). (Note that for women, information for 20 occupational categories was suppressed due to data release protocols.) For women, age-standardized all-cause mortality rates ranged from a low of approximately 120 deaths per 100,000 person-years to a high of 540 deaths per 100,000 person-years, while for men, the rates ranged from a low of approximately 450 deaths per 100,000 person-years to a high of 900 deaths per 100,000 person-years. Across the 80 minor groups, for both men and women, there was a generally linear trend in the correlation of mortality for causes amenable to medical care and mortality for all other causes of death. There was no evidence that at higher rates of mortality, a higher proportion of deaths were attributed to causes amenable to medical care.

DISCUSSION

Applying occupation as a measure of socio-economic status, this study found a similar gradient in mortality for causes amenable to medical care and for all other causes of mortality for both men and women in Canada over the period 1991-2001. While the proportion of deaths attributable to causes amenable to medical care was higher for women than for men, for both men and women the ratio of age-standardized mortality rates for causes amenable to medical

Appendix A. Causes of death considered amenable to medical care, showing International Classification of Diseases codes for each cause according to the 9th and 10th revisions

Cause of Death	Age	9th Revision	10th Revision
Tuberculosis	0-74	010-8, 137	A15-9,B90
Other infections (diphtheria, tetanus, septicaemia, poliomyelitis)	0-74	032,037,038,045	A36,A35,A40-1, A80
Malignant neoplasm of colon and rectum	0-74	153-4	C18-21
Malignant neoplasm of skin	0-74	173	C44
Malignant neoplasm of the female breast	0-74	174	C50
Malignant neoplasm of cervix uteri	0-74	180	C53
Malignant neoplasm of the body of the uterus, part unspecified	0-44	179,182	C54,C55
Malignant neoplasm of testis	0-74	186	C62
Hodgkin's disease	0-74	201	C81
Leukaemia	0-44	204-8	C91-5
Diseases of the thyroid	0-74	240-6	E00-7
Diabetes	0-49	250	E10-4
Epilepsy	0-74	345	G40-1
Chronic rheumatic heart disease	0-74	393-8	I05-9
Hypertensive disease	0-74	401-5	I10-3,I15
Ischaemic heart disease: 50% of deaths	0-74	410-4	I20-5
Cerebrovascular disease	0-74	430-8	I60-9
Influenza	0-74	487	J10-1
Pneumonia	0-74	480-6	J12-8
Peptic ulcer	0-74	531-3	K25-7
Appendicitis	0-74	540-3	K35-8
Abdominal hernia	0-74	550-3	K40-6
Cholelithiasis and cholecystitis	0-74	574-5.1	K80-1
Nephritis and nephrosis	0-74	580-9	N00-7,N17-9,N25-7
Benign prostatic hyperplasia	0-74	600	N40
Misadventures to patients during surgical and medical care	0-74	E870-6,E878-9	Y60-9,Y83-4
Maternal death	0-74	630-76	O00-99
Congenital cardiovascular anomalies	0-74	745-7	Q20-8
Perinatal deaths, all causes (excl. stillbirths)	0-74	760-79	P00-96

Source: Ref. 10 (Causes of death exclusive to children aged 0-14 have been excluded)

care relative to all other causes of death was similar across a five-level ranking of occupations by skill level.

Results recently reported by Mackenbach and colleagues investigating socio-economic inequalities in mortality among 22 countries in Europe[11] found that mortality due to causes amenable to medical intervention accounted for approximately 6% of the difference in mortality between those with the lowest and those with the highest levels of education. In contrast, smoking-related conditions accounted for 21% of the socio-economic inequality in mortality among men and 6% among women.

A number of recent studies have reported on trends in avoidable mortality. Using the same definitions applied in this study, Wheller and colleagues documented strong reductions in mortality due to causes amenable to medical care among men and women in the United Kingdom over the period 1993-2005.[12] Over this period, the age-standardized mortality rate for deaths due to causes amenable to medical care declined by 43% for men and 38% for women. In contrast, mortality due to all other causes declined by 14% for men and 8% for women. A recent Canadian study applying a definition of mortality amenable to medical care with minor differences to the classification applied in this study, documented a reduction of 47% in deaths at ages less than 65 due to such causes over the period 1975-1999 compared to a reduction of 25% in mortality not amenable to medical care.[13] Nolte and McKee recently described trends in deaths before age 75 classified as amenable to health care for 19 countries over the period 1997-2003.[10] Among men, medically-amenable mortality fell by an average of 17% over this period and deaths due to non-amenable causes fell by an average of 8%. Among women, medically-amenable mortality fell by an average of 14% and deaths due to non-amenable causes fell by an average of 6%.

None of these studies, however, described socio-economic gradients in avoidable mortality. As noted in the introduction, a recent Canadian study reporting on trends in avoidable mortality relative to socio-economic status documented greater reductions in absolute mortality differences for causes of death amenable to medical care than for all other causes of death over a 25-year period.[2] This study complements this earlier work by documenting limited evidence for differences in the proportion of all-cause mortality due to causes amenable to medical care across occupational groups in Canada. This finding may be interpreted to indicate that the Canadian health care system provides access to effective care equitably across socio-economic groups. Alternatively, the higher mortality rate due to causes amenable to medical care for persons in lower socio-economic positions may indicate that barriers to access are present if the underlying prevalence rates are similar across groups. Further research is required to resolve the implications of these findings.

There are a number of important strengths of the Canada census mortality follow-up study, including a very large sample broadly representative of the non-institutional adult population of Canada in 1991. There are also a number of limitations to acknowledge. Occupation and labour force activity were known only at baseline and the census contained no information on behavioural risk factors. Also, while the shift in 2000 from the use of ICD-9 to ICD-10 for the classification of deaths[26] may have influenced the socio-economic distribution of certain causes of death, we believe the potential impact of this influence to be small.

In conclusion, this study found a similar occupational gradient in mortality for causes amenable to medical care and for all other causes of mortality for both men and women in Canada over the period 1991-2001. Avoidable mortality is a valuable indicator of population health, providing information on outcomes pertinent to the organization and delivery of health care services.

REFERENCES

1. Wilkins R, Tjepkema M, Mustard CA, Choinière R. The Canadian census mortality follow-up study, 1991 through 2001. *Health Rep* 2008;19(3):25-43.

Appendix B. Mortality for causes amenable to medical care and for all other causes, by occupation minor group, non-institutionalized women aged 30 to 69 at cohort inception, Canada 1991-2001
Sorted by occupation minor group codes of the 1980 Standard Occupational Classification

Occupation Minor Group Code	Label	Person-years at Risk	Mortality Amenable to Medical Care			All Other Cause Mortality		
			Deaths	ASMR	95% Confidence Limits	Deaths	ASMR	95% Confidence Limits
111	Govt officials/administrators	59,415	47	140.5	96.2-205.3	74	214.3	155.7-294.9
113/114/115	Other managers/administrators	587,966	476	132.9	118.1-149.5	722	209.1	189.3-230.9
117	Management/administration	282,487	204	131.0	108.9-157.6	319	216.9	186.4-252.4
211	Physical sciences	12,818	5	33.5	13.3-83.9	11	85.9	43.5-169.6
213	Life sciences	13,345	4	44.3	15.4-126.9	13	325.6	162.7-651.4
214/215	Architects/engineers/community planners	24,301	13	73.7	37.8-143.4	13	174.8	76.9-397.6
216	Other architecture/engineering	20,356	14	103.5	55.0-194.5	21	224.1	107.4-467.6
218	Math/stats/systems analysis/related	55,911	28	105.2	63.1-175.4	44	186.7	102.7-339.2
231	Social sciences	26,886	15	136.3	62.9-295.1	28	173.8	103.0-293.3
233	Social work/related	144,226	138	137.0	111.2-168.8	219	241.3	202.2-288.1
234	Law/jurisprudence	30,793	20	204.7	102.6-408.5	35	233.0	137.6-394.7
235	Library/museum/and archival sciences	36,668	35	114.6	78.6-167.2	46	168.0	118.6-238.0
239	Other social sciences/related	16,804	16	196.8	74.2-521.8	25	324.1	167.4-627.6
251	Religion	14,968	28	120.5	78.7-184.7	36	152.5	107.1-217.0
271	University teaching/related	30,470	22	73.8	46.7-116.6	27	135.8	86.7-212.6
273	Elementary-secondary teaching/related	482,096	387	128.9	108.0-153.9	456	179.8	152.8-211.5
279	Other teaching/related	126,872	87	92.9	71.9-120.0	160	225.4	183.9-276.3
311	Health diagnosing/treating	32,287	14	63.4	34.7-115.9	28	161.4	103.7-251.1
313	Nursing/therapy/assisting related	623,761	514	121.5	107.0-138.0	788	190.6	171.2-212.1
315/316	Other medicine/health	148,275	100	147.3	110.9-195.8	136	192.0	147.9-249.2
331	Fine/commercial art/photography/related	48,807	35	113.4	77.6-165.7	62	202.2	149.6-273.1
333	Performing/audio-visual arts	18,831	18	139.7	84.8-230.0	24	206.4	134.6-316.5
335	Writing	36,388	25	95.9	62.2-147.7	34	147.8	102.0-214.0
336/337	Sports/recreation	15,971	14	154.7	82.3-290.9	16	141.1	76.2-261.1
411	Stenographic/typing	692,813	561	116.1	104.8-128.6	926	222.7	205.1-241.8
413	Bookkeeping/account-recording/related	838,865	771	133.8	122.7-145.9	1151	217.9	202.7-234.2
414	Office machine/related equip operating	145,601	123	145.8	114.7-185.3	186	246.9	198.4-307.2
415	Material recording/scheduling/distributing	85,479	82	151.8	113.4-203.2	124	235.3	185.2-298.8
416	Library/file/correspondence clerks/related	46,283	42	109.8	77.7-155.2	64	218.1	161.3-295.0
417	Reception/information/mail/message dist	268,480	302	151.6	132.2-173.8	474	252.1	225.7-281.6
419	Other clerical/related	425,158	474	156.4	140.0-174.8	608	228.5	206.4-252.9
513/514	Sales in commodities	535,508	610	138.9	126.8-152.1	850	208.7	192.9-225.8
517	Sales in services	121,302	104	130.9	103.4-165.9	168	230.7	191.7-277.6
519	Other sales	15,824	11	85.8	43.2-170.4	18	144.7	83.9-249.7
611	Protective services	52,498	70	182.1	139.2-238.1	104	299.7	240.7-373.1
612	Food-beverage prep/related	423,093	489	158.0	141.1-176.9	785	266.5	243.2-292.0
613	Lodging/Other accommodation	61,416	79	136.0	106.1-174.3	157	318.4	266.5-380.5
614	Personal service	303,924	296	135.5	118.8-154.6	442	228.0	203.8-255.2
616	Apparel/furnishings service	37,166	48	127.7	91.8-177.6	74	253.2	191.3-335.2
619	Other service	251,616	335	140.2	124.2-158.4	514	238.7	215.4-264.4
711	Farmers	47,758	81	133.6	107.0-166.8	112	182.7	151.3-220.6
718/719	Other farm/horticultural/animal husbandry	108,094	119	119.3	98.9-143.8	187	199.2	171.3-231.7
731	Fishing/trapping/related	12,557	–	–	–	–	–	–
751	Forestry/logging	6469	–	–	–	–	–	–
771	Mining/quarrying incl oil and gas field	1709	–	–	–	–	–	–
811	Mineral ore treating	–	–	–	–	–	–	–
813/814	Metal processing/related	3291	–	–	–	–	–	–
815	Clay-glass-stone processing/forming	2875	4	171.5	60.2-488.8	5	173.0	70.5-424.4
816/817	Chemicals/petroleum/rubber/plastic/related	9806	6	93.9	39.5-223.2	14	199.9	99.4-402.2
821/822	Food/beverage/related processing	102,141	95	116.7	88.9-153.4	153	230.5	181.8-292.2
823	Wood processing (except pulp/papermaking)	–	–	–	–	–	–	–
825	Pulp/papermaking/related	3144	–	–	–	–	–	–
826/827	Textile processing	16,771	11	61.9	33.3-114.9	25	219.5	123.4-390.6
829	Other processing	3198	–	–	–	–	–	–
831	Metal machining	6439	–	–	–	–	–	–
833	Metal shaping/forming (except machining)	9408	12	148.5	80.6-273.5	19	385.7	158.5-938.7
835	Wood machining	1272	–	–	–	–	–	–
837	Clay-glass-stone-related machining	2100	–	–	–	–	–	–
839	Other machining/related	2264	–	–	–	–	–	–
851/852	Fabricate/assemble (metal products)	26,421	23	159.0	72.3-349.7	35	262.2	135.6-507.1
853	Fabricate/assmbl/install/repair elctr equip	31,686	22	75.4	47.7-119.2	41	266.1	166.2-426.0
854	Fabricate/assemble/repair(wood products)	7707	9	107.4	55.4-208.1	16	228.0	127.3-408.3
855/856	Fabricate/assemble/repair(txtl/fur/leather)	189,272	169	96.6	80.7-115.6	276	200.8	170.5-236.5
857	Fabricate/assemble/repair(rubber/plastic)	9479	9	93.5	48.2-181.5	15	186.1	108.8-318.4
858	Other mechanics/repairers	6569	–	–	–	–	–	–
859	Other product fabricate/assemble/repair	22,173	14	96.1	44.0-209.8	32	188.5	118.7-299.2
871	Excavating/grading/paving/related	2128	–	–	–	–	–	–
873	Electric power/lighting/wire comm equip	7567	–	–	–	–	–	–
878/879	Other construction trades	16,453	18	170.8	95.6-305.3	24	368.6	219.8-618.2
911	Air transport operating	2683	–	–	–	–	–	–
913	Railway transport operating	1174	–	–	–	–	–	–
915	Water transport operating	–	–	–	–	–	–	–
917	Motor transport operating	60,634	63	133.4	93.4-190.6	77	211.8	149.4-300.2
919	Other transport equipment operating	–	–	–	–	–	–	–
931	Other material handling/related	67,421	76	132.1	99.5-175.3	118	248.4	191.2-322.8
951	Printing/related	30,846	19	62.1	38.8-99.5	59	291.2	204.0-415.7
953	Stationary engine/utilities equip oper.	2496	–	–	–	–	–	–
955	Other elctrnc communication equip oper.	2436	–	–	–	–	–	–
959	Other crafts/equipment operating	6119	8	196.2	92.0-418.5	9	241.4	108.6-536.8
991/992	Occupations not elsewhere classified	71,110	100	198.5	154.4-255.2	104	182.2	143.5-231.5
	All Occupations (Reference Group)	**8,104,376**	**7595**	**132.3**	**128.7-136.1**	**11,404**	**218.6**	**213.6-223.8**

The counts of deaths for occupations recording fewer than three deaths are suppressed.

Appendix C. Mortality for causes amenable to medical care and for all other causes, by occupation minor group, non-institutionalized men aged 30 to 69 at cohort inception, Canada 1991-2001

Sorted by occupation minor group codes of the 1980 Standard Occupational Classification

Occupation Minor Group Code	Label	Person-years at Risk	Mortality Amenable to Medical Care			All Other Cause Mortality		
			Deaths	ASMR	95% Confidence Limits	Deaths	ASMR	95% Confidence Limits
111	Govt officials/administrators	113,181	170	196.1	163.8-234.9	364	411.4	363.5-465.5
113/114/115	Other managers/administrators	1,214,450	1637	182.2	172.1-192.8	3280	377.7	362.5-393.6
117	Management/administration	325,769	463	187.1	169.0-207.2	872	380.7	353.0-410.5
211	Physical sciences	48,202	39	116.9	81.3-168.1	95	370.7	285.9-480.8
213	Life sciences	38,201	33	139.1	91.8-211.0	63	290.0	211.0-398.5
214/215	Architects/engineers/community planners	239,422	247	153.9	133.7-177.2	550	341.9	310.8-376.2
216	Other architecture/engineering	136,642	143	205.7	165.2-256.1	296	331.3	282.8-388.0
218	Math/stats/systems analysis/related	124,459	74	163.1	113.0-235.4	160	342.8	262.6-447.4
231	Social sciences	30,872	31	148.1	99.5-220.4	63	337.7	255.0-447.3
233	Social work/related	49,582	80	266.7	205.7-345.8	151	479.5	393.9-583.7
234	Law/jurisprudence	64,796	73	166.3	130.5-211.9	151	337.5	284.2-400.9
235	Library/museum/and archival sciences	8728	10	145.2	72.6-290.2	26	404.2	264.7-617.1
239	Other social sciences/related	9938	18	211.4	114.3-390.8	20	235.8	133.6-416.2
251	Religion	43,191	86	151.6	122.3-187.8	196	348.9	302.7-402.2
271	University teaching/related	62,355	61	118.2	89.3-156.4	146	274.6	228.9-329.3
273	Elementary-secondary teaching/related	208,111	179	152.1	118.6-195.0	411	362.3	304.2-431.5
279	Other teaching/related	86,523	99	166.9	132.3-210.5	259	412.0	356.4-476.1
311	Health diagnosing/treating	90,361	115	143.0	118.7-172.2	246	311.8	274.5-354.2
313	Nursing/therapy/assisting related	58,046	71	238.7	170.8-333.5	166	414.4	334.2-513.7
315/316	Other medicine/health	52,420	70	171.8	134.0-220.2	135	352.0	294.2-421.1
331	Fine/commercial art/photography/related	53,066	60	165.5	126.3-216.9	157	417.7	352.9-494.5
333	Performing/audio-visual arts	34,056	35	185.2	129.3-265.1	85	404.8	318.5-514.5
335	Writing	32,494	51	206.5	154.5-276.0	101	431.0	349.5-531.4
336/337	Sports/recreation	24,109	52	273.5	203.9-366.7	101	584.1	470.9-724.4
411	Stenographic/typing	7644	22	268.1	173.9-413.2	32	430.9	301.0-616.9
413	Bookkeeping/account-recording/related	102,373	208	243.5	211.0-281.0	401	496.8	447.3-551.8
414	Office machine/related equip operating	36,924	52	232.2	161.8-333.4	92	414.1	312.5-548.6
415	Material recording/scheduling/distributing	189,924	350	252.1	221.3-287.2	636	479.1	433.2-529.9
416	Library/file/correspondence clerks/related	5284	11	267.6	145.0-494.0	18	457.2	280.9-744.4
417	Reception/information/mail/message dist	88,727	158	245.0	205.3-292.3	326	497.4	438.3-564.5
419	Other clerical/related	117,533	234	239.8	208.6-275.6	425	453.3	407.7-503.9
513/514	Sales in commodities	547,136	968	220.9	206.3-236.5	1844	447.5	425.4-470.7
517	Sales in services	178,559	320	198.7	177.1-222.8	591	385.7	354.3-419.8
519	Other sales	26,224	45	282.9	196.3-407.7	102	593.1	466.2-754.5
611	Protective services	302,102	649	284.4	262.1-308.6	1222	568.3	535.2-603.4
612	Food-beverage prep/related	151,732	273	252.0	219.0-290.1	581	513.2	465.2-566.1
613	Lodging/Other accommodation	20,076	80	339.1	270.6-424.9	135	578.5	486.4-688.1
614	Personal service	39,240	90	254.4	204.7-316.2	175	497.2	425.7-580.6
616	Apparel/furnishings service	16,345	32	190.9	131.8-276.5	69	478.1	365.4-625.5
619	Other service	236,566	653	254.7	234.6-276.5	1234	529.1	497.9-562.2
711	Farmers	207,987	589	204.0	187.8-221.7	1139	414.4	390.0-440.3
718/719	Other farm/horticultural/animal husbandry	149,957	358	240.5	216.4-267.4	697	485.8	450.3-524.1
731	Fishing/trapping/related	63,807	127	226.5	186.4-275.2	256	532.3	460.4-615.5
751	Forestry/logging	100,163	147	230.2	183.2-289.2	374	512.0	441.6-593.6
771	Mining/quarrying incl oil and gas field	87,370	144	257.9	206.7-321.8	289	555.3	465.0-663.2
811	Mineral ore treating	10,135	17	268.1	135.0-532.5	34	437.9	275.8-695.1
813/814	Metal processing/related	57,434	117	297.6	224.6-394.2	194	444.6	360.3-548.5
815	Clay-glass-stone processing/forming	14,064	33	283.5	188.3-427.0	66	554.8	419.1-734.4
816/817	Chemicals/petroleum/rubber/plastic/related	40,311	49	177.0	130.8-239.4	97	437.0	320.0-596.6
821/822	Food/beverage/related processing	128,568	198	228.7	190.8-274.1	424	467.5	412.1-530.3
823	Wood processing (except pulp/papermaking)	47,295	58	149.3	114.4-194.8	153	447.2	362.2-552.1
825	Pulp/papermaking/related	54,389	85	300.7	203.0-445.3	168	586.4	441.6-778.7
826/827	Textile processing	17,759	28	178.6	116.4-274.2	58	362.1	268.7-488.1
829	Other processing	4176	12	306.5	169.5-554.0	19	499.6	311.6-801.0
831	Metal machining	106,048	156	201.2	165.9-243.9	301	385.2	335.4-442.4
833	Metal shaping/forming (except machining)	182,699	284	227.2	195.2-264.5	617	502.0	450.9-558.9
835	Wood machining	12,683	22	394.1	211.7-733.6	30	287.8	174.5-474.8
837	Clay-glass-stone-related machining	8706	16	235.1	138.0-400.5	24	368.1	233.0-581.4
839	Other machining/related	16,281	29	232.8	144.5-375.0	49	451.7	306.4-666.0
851/852	Fabricate/assemble (metal products)	101,122	135	207.5	160.8-267.8	274	439.9	365.7-529.2
853	Fabricate/assmbl/install/repair elctr equip	127,254	194	234.2	194.1-282.5	345	429.3	370.3-497.7
854	Fabricate/assemble/repair(wood products)	45,950	76	205.9	160.5-264.2	130	367.5	301.9-447.4
855/856	Fabricate/assemble/repair(txtl/fur/leather)	48,083	94	220.2	176.7-274.5	205	472.5	407.1-548.4
857	Fabricate/assemble/repair(rubber/plastic)	23,693	39	303.6	193.5-476.3	65	549.2	388.0-777.5
858	Other mechanics/repairers	434,224	610	219.7	197.5-244.4	1327	475.3	441.4-511.7
859	Other product fabricate/assemble/repair	75,045	142	255.2	209.9-310.4	263	515.9	444.1-599.3
871	Excavating/grading/paving/related	160,985	337	248.5	217.3-284.2	632	525.7	473.2-584.1
873	Electric power/lighting/wire comm equip	190,601	227	216.4	178.6-262.3	445	418.2	364.0-480.4
878/879	Other construction trades	681,154	1093	209.7	195.0-225.6	2490	510.3	485.5-536.5
911	Air transport operating	28,776	23	150.7	85.0-267.4	59	323.3	231.5-451.7
913	Railway transport operating	35,536	52	202.6	140.3-292.5	110	415.3	322.1-535.5
915	Water transport operating	26,145	59	240.0	178.6-322.5	111	463.7	372.2-577.7
917	Motor transport operating	509,257	1102	276.6	257.6-297.1	2152	551.3	523.5-580.7
919	Other transport equipment operating	10,683	15	140.9	84.1-236.1	46	587.0	405.9-848.9
931	Other material handling/related	178,409	363	262.9	232.0-298.0	677	532.2	482.3-587.3
951	Printing/related	59,100	108	271.0	208.9-351.5	192	517.8	425.1-630.8
953	Stationary engine/utilities equip oper.	72,994	123	228.0	183.0-284.1	217	391.8	331.4-463.2
955	Other elctrnc communication equip oper.	12,351	19	275.2	160.2-473.0	20	286.8	168.1-489.2
959	Other crafts/equipment operating	7191	9	285.7	133.0-613.8	23	497.3	301.2-821.1
991/992	Occupations not elsewhere classified	248,614	544	256.0	232.7-281.7	1078	530.6	494.8-568.9
	All Occupations (Reference Group)	**9,602,356**	**15,875**	**216.6**	**212.8-220.4**	**31,827**	**449.3**	**443.6-455.0**

The counts of deaths for occupations recording fewer than three deaths are suppressed.

2. James PD, Wilkins R, Detsky AS, Tugwell P, Manuel DG. Avoidable mortality by neighbourhood income in Canada: 25 years after the establishment of universal health insurance. *J Epidemiol Community Health* 2007;61:287-96.
3. Roos NP, Mustard CA. Variation in health and health care use by socioeconomic status in Winnipeg, Canada: Does the system work well? Yes and no. *Milbank Q* 1997;75:89-111.
4. Anderson G, Bronskill SE, Mustard CA, Culyer A, Alter DA, Manuel DG. Both clinical epidemiology and population health perspectives can define the role of health care in reducing health disparities. *J Clin Epidemiol* 2005;58:751-62.
5. Alter DA, Naylor CD, Austin P, Tu JV. Effects of socioeconomic status on access to invasive cardiac procedures and on mortality after acute myocardial infarction. *N Engl J Med* 1999;341:1359-67.
6. Pampalon R. Avoidable mortality in Quebec and its regions. *Soc Sci Med* 1993;37(6):823-31.
7. Tobias M, Jackson G. Avoidable mortality in New Zealand, 1981-97. *Aust N Z J Public Health* 2001;25(1):12-20.
8. Carr-Hill RA, Hardman GF, Russell IT. Variations in avoidable mortality and variations in health care resources. *Lancet* 1987;1(8536):789-92.
9. Manuel D, Mao Y. Avoidable mortality in the United States and Canada, 1980-1996. *Am J Public Health* 2002;92:1481-84.
10. Nolte E, McKee CM. Measuring the health of nations: Updating an earlier analysis. *Health Affairs* 2008;27(1):58-71.
11. Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, Kunst AE. Socioeconomic inequalities in health in 22 European countries. *N Engl J Med* 2008;358:2468-81.
12. Wheller L, Baker A, Griffiths C, Rooney C. Trends in avoidable mortality in England and Wales, 1993-2005. *Health Stat Q* 2007;34:6-25.
13. James PD, Manuel DG, Mao Y. Avoidable mortality across Canada from 1975 to 1999. *BMC Public Health* 2006;6:137.
14. Elo IT, Preston SH. Educational differentials in mortality: United States, 1979-85. *Soc Sci Med* 1996;42(1):47-57.
15. Rogot E, Sorlie PD, Johnson NJ, Glover CS, Treasure D. A mortality study of one million persons by demographic, social, and economic factors: 1979-1981 follow-up. (First data book). (NIH Publ No. 88-2896.) Washington, DC: US DHHS, Public Health Service,1988.
16. Leclerc A, Chastang JF, Menvielle G, Luce D. Socioeconomic inequalities in premature mortality in France: Have they widened in recent decades? *Soc Sci Med* 2006;62(8):2035-45.
17. Valkonen T, Martelin T, Rimpela A. Socio-economic mortality differences in Finland 1971-85. Population Series. Helsinki: Statistics Finland, 1990.
18. Diderichsen F, Hallqvist J. Trends in occupational mortality among middle-aged men in Sweden 1961-1990. *Int J Epidemiol* 1997;26(4):782-87.
19. Statistics Canada. Standard Occupational Classification 1980. Catalogue 12-565E. Ottawa, ON: Minister of Supply and Services Canada, 1981.
20. Employment and Immigration Canada. National Occupational Classification: Occupational descriptions. Ottawa: Canada Communications Group, 1993.
21. Charlton JR, Hartley RM, Silver R, Holland WW. Geographical variation in mortality from conditions amenable to medical intervention in England and Wales. *Lancet* 1983;1:691-96.
22. Holland WW (Ed.). *European Community Atlas of "Avoidable Death"*. European Community Health Services Research Series No. 3. Oxford: Oxford University Press, 1988.
23. World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death,* Ninth Revision. Geneva: WHO, 1977.
24. World Health Organization. *International Statistical Classification of Diseases and Related Health Problems,* Tenth Revision. Geneva: WHO, 1992.
25. Aronson KJ, Howe GR, Carpenter M, Fair ME. Surveillance of potential associations between occupations and causes of death in Canada, 1965-91. *Occup Environ Med* 1999;56(4):265-69.
26. Geran L, Tully P, Wood P, Thomas B. Comparability of ICD-10 and ICD-9 for mortality statistics in Canada. Cat no. 84-548-XIE. Ottawa: Statistics Canada, 2005.

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RÉSUMÉ

Objectif : Décrire l'incidence de la mortalité évitable dont les causes sont traitables par des soins médicaux au sein de groupes de professions au Canada.

Méthode : Étude de cohortes menée sur une période de 11 ans auprès d'un échantillon représentatif de 15 % de la population hors-établissement du Canada âgée de 30 à 69 ans lors de la première cohorte. Nous avons calculé les taux de mortalité normalisés selon l'âge pour les causes traitables par des soins médicaux et pour toute autre cause de décès chez les hommes et les femmes ayant une activité professionnelle dans cinq catégories de compétences et 80 groupes professionnels particuliers, ainsi que chez les personnes inactives sur le plan professionnel.

Résultats : Chez les femmes actives, les taux de mortalité normalisés selon l'âge pour 100 000 personnes à risque/année étaient de 132,3 pour les causes traitables par des soins médicaux et de 218,6 pour toute autre cause. Chez les hommes actifs, ces taux étaient de 216,6 et de 449,3, respectivement. Les décès de causes traitables par des soins médicaux et de toute autre cause, chez les deux sexes, présentaient un gradient selon les cinq niveaux de compétences professionnelles, mais ce gradient était moins prononcé chez les femmes que chez les hommes. Dans les 80 groupes professionnels mineurs, tant chez les hommes que chez les femmes, nous avons observé une relation linéaire entre les taux pour les causes traitables par des soins médicaux et les taux pour toute autre cause.

Conclusion : Chez les adultes ayant une activité professionnelle, notre étude a constaté des gradients semblables dans la mortalité pour des causes traitables par des soins médicaux et pour toutes les autres causes de mortalité entre 1991 et 2001. La mortalité évitable est un bon indicateur de santé des populations, car elle donne de l'information sur les résultats de santé pertinents pour l'organisation et la prestation des services de santé.

Mots clés : professions; cause de décès; recherche sur les services de santé