ORIGINAL ARTICLE

Association between the burden of disease and research funding by the Medical Research Council of Canada and the National Institutes of Health. A cross-sectional study

Maxime Lamarre-Cliche, MD*†
Anne-Marie Castilloux, MSc†
Jacques LeLorier, MD, PhD*†

From the *Department of Medicine, Faculty of Medicine, Université de Montréal, †Centre de recherche, Centre Hospitalier de l'Université de Montréal, Hôtel-Dieu Campus, Montreal, Que.

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Abstract

Background: The Medical Research Council of Canada (MRCC) is the major Canadian agency responsible for funding biomedical health research in this country. Disease-specific funding by the United States National Institutes of Health (NIH) has been studied and is not independent of burden-of-disease parameters. We tested the association between disease-specific MRCC funding, disease-specific NIH funding and various burden-of-disease parameters.
Method: Information on 1994/99 MRCC funding was obtained from the MRCC database for 29 diseases. NIH funding and burden-of-disease counterparts for the year 1996 were gleaned from a recent publication. The association between data series was measured by correlation coefficients.
Results: Disease-specific incidence, mortality and years-of-life lost did not correlate significantly with 1994/99 disease-specific MRCC funding but prevalence (r = 0.54, p = 0.005) and disability-adjusted life-years did (r = 0.48, p = 0.009). A correlation coefficient of 0.50 (p = 0.006) was calculated between 1996 NIH funding and 1996/97 MRCC funding. Two disease categories, cirrhosis and alcohol abuse, received a greater percentage of funds from the NIH than from the MRCC. Two other disease categories, epilepsy and perinatal disease, received a greater percentage of funds from the MRCC than from the NIH.
Conclusions: Disease-specific MRCC grants in the past 5 years correlated with 2 of the usual burden-of-disease parameters: disability-adjusted life-years and disease prevalence. A statistically-significant correlation was observed between disease-specific grants awarded by the MRCC and the NIH.

Résumé

Contexte : Le Conseil de recherches médicales du Canada (CRMC) est le principal organisme canadien chargé de financer la recherche biomédicale en santé au Canada. Le financement spécifique à des maladies par les National Institutes of Health (NIH) américains a fait l'objet d'études et n'est pas indépendant des paramètres liés au fardeau de la maladie. Nous avons étudié le lien entre le financement du CRMC spécifique à une maladie, le financement des NIH spécifique à une maladie et divers paramètres liés au fardeau de la maladie.
Méthode : On a tiré de la base de données du CRMC, pour 29 maladies, des données sur le financement accordé par le CRMC entre 1994 et 1999. Les données sur le financement des NIH et le financement correspondant lié au fardeau de la maladie pour l'année 1996 ont été tirées d'une publication récente. On a mesuré le lien entre les séries de données au moyen de coefficients de corrélation.
Résultats : Il n'y avait pas de liens importants entre

l'incidence spécifique de maladies, la mortalité et les années de vie perdues, d'une part, et le financement spécifique à une maladie accordé par le CRMC entre 1994 et 1999, de l'autre, mais il y avait un lien important entre la prévalence (r = 0,54, p = 0,005) et les années de vie ajustées en fonction de l'incapacité (r = 0,48, p = 0,009). On a calculé un coefficient de corrélation de 0,50 (p = 0,006) entre le financement accordé par les NIH en 1996 et celui que le CRMC a accordé en 1996–1997. Deux catégories de maladie, soit la cirrhose et l'alcoolisme, ont reçu plus de fonds des NIH que du CRMC. Deux autres catégories de maladie, soit l'épilepsie et les maladies périnatales, ont reçu plus de fonds du CRMC que des NIH.

Conclusions : On a établi un lien entre les subventions spécifiques à une maladie accordées par le CRMC au cours des cinq dernières années et deux des paramètres habituels liés au fardeau de la maladie : années de vie ajustées en fonction de l'incapacité et prévalence de la maladie. On a observé un lien significatif sur le plan statistique entre les subventions spécifiques à une maladie accordées par le CRMC et par les NIH.

Introduction

The Medical Research Council of Canada (MRCC) was the major Canadian agency responsible for funding biomedical health research in Canada until June 2000. Its budget was over Can$300 million.[1] Operating grants represented about 90% of total MRCC grant disbursements.[1,2] The MRCC selected, by peer review, research projects that would receive funding support. The investigator's track record, importance of the working hypothesis, importance of the research's contribution, aptitude of the research project to address the working hypothesis and its overall quality were of utmost importance in rating the applicant. More than 3000 applicants submitted their applications each year. In the March 1999 competition only 28% of new applicants and 59% of renewals were awarded research funds. Some have questioned the distribution of research funding by public organizations for various diseases.[3–5]

Gross and associates[6] recently published a cross-sectional study in which various burden-of-disease measures were compared to disease-specific research funding by the United States National Institutes of Health (NIH). Their results suggested that funding allocations by the NIH are not independent of burden-of-disease parameters. In this context, we performed a similar cross-sectional study to analyze the association of MRCC fund allocations and common burden-of-disease measures.

Method

Data collection

Twenty-nine diseases were chosen for which information was available on the burden of disease.[6] From the MRCC database, disease-specific grant amounts were identified for the fiscal years 1994/99. The fiscal year 1996/97 was chosen for comparison with 1996 NIH grants, and a combination of the years 1994 to 1999 allowed better evaluation of MRCC funding for the last 5 years. The MRCC database is already classified by disease, and necessary information on 19 diseases was obtained directly from the code table. For the other 10 diseases, a computer search strategy from the MRCC database of operating grants was elaborated and validated by 2 investigators (M.L.C. and J.L.). Only research projects that focused on a specific disease were selected. Supportive research was excluded. Grants awarded by the MRCC to Canadian health-related organizations (other organization grants) were also added when disease-specific classifications could be obtained from these organizations.

Information on disease-specific NIH funding was obtained from Gross and associates.[6] Most burden-of-disease measures were also gleaned directly from this reference. Since the Canadian disease-specific burden of illness may be considered to be proportionally the same as in the United States, American and developed countries burden-of-disease measures were used in this analysis with the exception of cost of disease which was a Canadian measure. Gross and associates obtained incidence and prevalence data from the United States health statistics. Data on death rates, hospital days and disability-adjusted life-years were obtained from the Global Burden-of-disease Study.[7] Disability-adjusted life-years is an indicator of the time lived with a disability and the time lost due to premature death.[8]

The direct costs for disease were identified from Health Canada.[9]

Table 1: Summary of data on Medical Research Council of Canada (MRCC) and United States National Institutes of Health (NIH) funding and burden-of-disease parameters

Disease	MRCC 1996/97 research funding, $	R	MRCC 1994/99 research funding, $	R	NIH 1996 research funding, $	R	Incidence, no./yr	R	Prevalence , no.	R	Hospital days	R	Deaths, no.	R	Years of life lost, yr	R	DALY	R
DM	4 090	1	20 029	1	298 920	4	2 308	6	37 850	1	3 181	8	57	8	407	9	2 357	8
Injuries	3 060	2	14 834	2	198 700	7	NA		NA		15 218	1	149	3	3 109	1	8 608	2
AIDS	2 681	3	7 763	10	1 410 925	1	138	20	1 303	16	329	20	42	10	979	4	1 267	15
Breast ca.	2 378	4	12 162	3	381 880	2	523	12	262	21	525	18	44	9	426	8	1 421	14
DODs	2 147	5	11 810	4	187 100	8	NA		NA		158	25	0.1	28	1	28	870	18
Asthma	2 117	6	10 923	5	81 600	18	3 594	5	15 919	3	1 820	10	5	20	65	16	1 236	17
IHD	2 110	7	10 853	6	269 100	5	2 216	7	8 976	6	11 815	2	481	1	2 973	2	8 876	1
PCs	2 084	8	10 764	7	26 400	26	NA		NA		1 382	14	14	14	473	7	1 767	11
Epilepsy	1 550	9	8 093	9	55 100	24	504	13	4 511	10	483	19	1	25	25	23	505	20
Dementia	1 240	10	8 251	8	304 411	3	959	9	7 082	8	841	16	34	12	99	14	2 866	7
MS	1 092	11	5 325	12	82 800	17	16	24	461	20	149	26	2	23	28	22	236	25
Stroke	1 043	12	5 345	11	120 280	12	1 282	8	9 467	5	6 450	5	153	2	746	5	4 977	4
Schizophrenia	880	13	4 928	13	111 479	13	162	18	7 164	7	4 129	6	0.4	26	2	27	2 249	10
COPD	863	14	4 463	14	62 400	21	670	11	4 271	11	3 537	7	96	5	518	6	2 284	9
Depression	771	15	3 970	15	143 800	10	20 622	2	12 785	4	8 409	4	8	17	23	24	8 393	3
Uterine ca.	719	16	3 853	16	13 956	27	133	22	599	19	199	22	3	22	23	25	185	27
PD	644	17	3 726	18	77 158	19	136	21	1 849	15	162	24	10	16	36	19	447	21
Ovarian ca.	602	18	3 778	17	42 168	25	74	23	247	22	325	21	14	15	48	18	375	23
Lung ca.	440	19	2 164	20	127 796	11	430	16	874	18	1 536	12	149	4	1 158	3	2 987	6
Prostate ca.	440	20	2 716	19	92 661	16	452	15	2 020	13	585	17	35	11	153	13	574	19
Colorectal ca.	372	21	1 880	21	105 525	14	499	14	1 926	14	1 600	11	58	7	391	10	1 626	12
Peptic ulcer	326	22	1 646	22	6 000	29	944	10	5 005	9	1 440	13	6	19	35	20	239	24
Alcohol abuse	266	23	1 146	23	256 600	6	11 085	3	18 092	2	2 563	9	7	18	98	15	4 690	5
Cirrhosis	235	24	904	24	169 800	9	168	17	1 238	17	869	15	31	13	380	11	1 584	13
Cervical ca.	160	25	854	25	60 180	23	4	25	164	24	94	28	5	21	63	17	192	26
Otitis media	115	26	496	27	9 100	28	40 424	1	3 110	12	100	27	0.04	29	1	29	8	29
STD	98	27	625	26	102 583	15	NA		NA		69	29	0.3	27	28	21	404	22
Tuberculosis	58	28	467	28	64 125	20	155	19	39	25	163	23	2	24	15	26	118	28
Pneumonia	12	29	279	29	61 900	22	9 257	4	178	23	8 625	3	81	6	363	12	1 263	16

Estimates of incidence and prevalence apply to established market economies as defined by the World Bank in 1990; other estimates of burden of disease apply to the United States in 1994.
$ = thousands of dollars, R = rank, DALY = disability-adjusted life-years, NA= not available, DM = diabetes mellitus, ca. = cancer, DODs = dental and oral disorders, IHD = ischemic heart disease, PCs = pediatric conditions, MS = multiple sclerosis, COPD = chronic obstructive pulmonary disease, PD = Parkinson's disease, STD = sexually transmitted disease.

Statistical analysis

Correlation coefficients were calculated between MRCC fundings and burden-of-disease parameters. Correlation coefficients were always computed using both 1996/97 and combined 1994/99 MRCC fiscal years. Pearson correlations were calculated when the data were distributed normally. Spearman's correlation coefficients were estimated for data that were not normally distributed. Pearson's correlation coefficients of log-transformed data were determined for direct comparison with the results of Gross and associates.[6]

Predicted values of MRCC fundings were calculated with a linear regression model for log-transformed data, using a burden-of-disease parameter as the independent variable. Regression models were constructed for each of the burden-of-disease parameters that were significantly correlated with MRCC fundings.

Table 2: Direct cost of disease in Canada

Disease	Cost (in thousands Can$)
Injuries	3 121 596
Coronary artery disease	2 075 414
Stroke	1 444 934
Chronic obstructive pulmonary disease	1 328 470
Diabetes mellitus	577 031
Perinatal conditions	551 278
Female cancers	329 023

Results

Descriptive statistics of MRCC funding

The retrieved data on disease-specific NIH funding, disease-specific MRCC funding and burden-of-disease parameters are presented in Tables 1 and 2. The total funding for operating grants and other organization grants for the 29 diseases was about Can$36 million in 1996/97 and Can$176 million for the fiscal years 1994/99. Other organization grants represented 17% of the total amount for 1996/97 and 14.6 for the years 1994/99. Other organization grants for which the necessary information for disease categorization was not available represented 6% of the total in 1996/97 and 4.2% for 1994/99 combined. With respect to the number of disease-specific grants for 1996/97, the median number was 14 (range from 0 and 56 with an interquartile range of 17). Thirty-one percent of specific disease categories received less than 10 grants in 1996/97.

Correlation between MRCC funding and burden-of-disease measures

Correlation coefficients between MRCC funding and incidence, hospital days, mortality or years of life lost were not statistically different from 0 for both 1996/97 and 1994/99. Correlation coefficients between 1996/97 MRCC funding and disability-adjusted life-years ($r = 0.44$, $p = 0.02$) or prevalence ($r = 0.61$, $p = 0.001$) were statistically different from

Table 3: Correlation coefficients between measures of the burden of disease and amount of research funding

	MRC 1996/97		MRC 1994/99		NIH 1996	
Measure	*r*	*p* value	*r*	*p* value	*r*	*p* value
Incidence (no. of new cases/yr)	–0.1	0.64	–0.07	0.75	–0.05	0.82
Hospital days (d in acute care hospital)	0.21	0.27	0.28	0.14	0.24	0.21
Deaths/yr	0.21	0.27	0.25	0.19	0.4	0.03
Years of life lost	0.23	0.22	0.22	0.23	0.42	0.02
Disability-adjusted life-years	0.44	0.02	0.48	0.009	0.62	<0.001
Prevalence (no. of existing cases)	0.61	<0.001	0.54	0.005	0.25	0.23

Correlations were calculated using Pearson's correlation coefficient on log-transformed data.

0 (Table 3). Correlation coefficients between combined 1994/99 MRCC fundings and prevalence (r = 0.54, p = 0.005) or disability-adjusted life-years (r = 0.48, p = 0.009) were also statistically different from 0. The incidence of disease was the burden-of-disease parameter that consistently had the smallest correlation estimates with MRCC fundings.

Correlation between MRCC funding and the direct costs of disease

Direct costs were obtained for stroke, perinatal diseases, coronary artery disease, injuries, chronic obstructive pulmonary disease, diabetes mellitus and female cancers (Table 2). A negative and statistically nonsignificant correlation coefficient between these costs and 1994/99 MRCC funding (r = –0.25, p = 0.59) was demonstrated.

Differences between actual and predicted funding

Regression lines were drawn for 1996/97 MRCC fundings on the y axis and disability-adjusted life-years or prevalence on the x axis. Residuals for each disease were calculated and are presented in Table 4.

Table 4: Difference between actual and predicted Medical Research Council of Canada funding (in thousands of Can$) adjusted for disability-adjusted life-years (DALY) or prevalence

Disease	DALY	Prevalence
Alcohol abuse	–4 938	–5 897
Depression	–3 592	–2 189
Pneumonia	–3 447	–899
Cirrhosis	–3 151	–1 591
Lung cancer	–2 975	–17
Colorectal cancer	–2 215	–1 081
STD	–1 808	NA
Tuberculosis	–1 069	–188
Cervical cancer	–989	–288
Stroke	–875	–137
Peptic ulcer	–354	–2 638
COPD	–186	434
Otitis media	–65	–3 067
Prostate cancer	–59	–300
Schizophrenia	306	6
Parkinson	1 198	811
Ovarian cancer	1 411	2 440
Uterine cancer	2 035	1 968
Ischemic heart disease	3 131	5 482
Dementia	3 190	3 351
Multiple sclerosis	3 335	3 622
AIDS	4 033	5 218
Epilepsy	5 448	3 978
Perinatal conditions	6 540	NA
Injuries	7 201	NA
Asthma	7 227	4 220
Breast cancer	8 268	9 011
DODs	8 568	NA
Diabetes mellitus	15 325	10 658

Negative residuals indicate underfunding and positive residuals indicate overfunding relative to burden–of disease.
STD = sexually transmitted disease, COPD = chronic obstructive pulmonary disease, DODs = dental and oral disorders, NA = not available.

Correlation between NIH funding and MRCC funding

The correlation coefficient estimate between MRCC and NIH fundings for the year 1996/97 was 0.50 (p = 0.006). Fig. 1 presents the MRCC (x axis) and corresponding NIH (y axis) ranks for disease-specific funding. Diseases such as cirrhosis and alcohol abuse garnered a higher percentage of funds from the NIH in contrast to perinatal disease and epilepsy, which attracted a higher percentage of funds from the MRCC (Fig. 1).

Discussion

In this cross-sectional study, correlations were calculated between the amounts of 29 disease-specific MRCC operating grants and their corresponding burden-of-disease measures. Burden-of-disease parameters with correlation coefficients that were statistically different from 0 were prevalence and disability-adjusted life-years, especially for the combined 1994/99 MRCC fundings. The burden-of-disease parameter with the lowest correlation coefficient estimate was incidence.

The correlation coefficient between the 29 disease-specific 1996 NIH funding and corresponding 1996/97 MRCC grants was statistically different from 0.

The significant correlation between MRCC fundings and burden-of-disease parameters may be explained in 2 ways. It is logical that diseases generating the greatest burden elicit more attention from the research community. The MRCC, therefore, receives

a greater number of grant applications related to such diseases. If grants are attributed to the highest quality applications and if application quality is independent of the disease studied, correlation between the burden of disease and the total amount of disease-specific grants should be expected. Since the burden of disease is implicitly included in MRCC criteria for grant approval, logically it could also be influential enough to generate significant correlation coefficients with the total amount of disease-specific grants.

Negative but nonsignificant correlation between MRCC funding and disease incidence results from very frequent but not very morbid diseases that may attract less attention from the research community and the MRCC (e.g., otitis media). Other burden-of-disease parameters such as mortality, years of life lost and days spent in acute care hospitals were not significantly associated with MRCC funding. Interpretation of these results should consider the possible presence of a variety of selection biases and confounders. Different valuation of certain health outcomes may also explain our results. In addition, it is noteworthy that different disease categorization (e.g., lumping of all cancers and cardiovascular diseases) could change our results.

Similar MRCC and NIH funding-to-burden correlation coefficients and a statistically significant correlation coefficient between MRCC and NIH disease-specific funding were to be expected. It is noteworthy though that, unlike the NIH, 1996/97 MRCC funding and disease-specific mortality were not significantly correlated (Table 3). In addition, some discrepancies were observed between NIH and MRCC disease-specific funding ranks (Fig. 1). The NIH targets certain groups of disease and conducts intramural research whereas the MRCC is entirely devoted to extramural research and does not give priority to any group of diseases. Such structural differences could provide an explanation for the discrepancies observed. Some disease categories, such as alcohol abuse and cirrhosis, did not receive many grants from the MRCC; therefore, small differences in the number of grants may account for large differences in ranks and lower correlation estimates. An obvious confounder would be systematic differences in disease classification between the MRCC and the NIH. The NIH employs technical information specialists who read and index all awarded grants whereas the MRCC uses the author's classification of the research project. Another obvious confounder

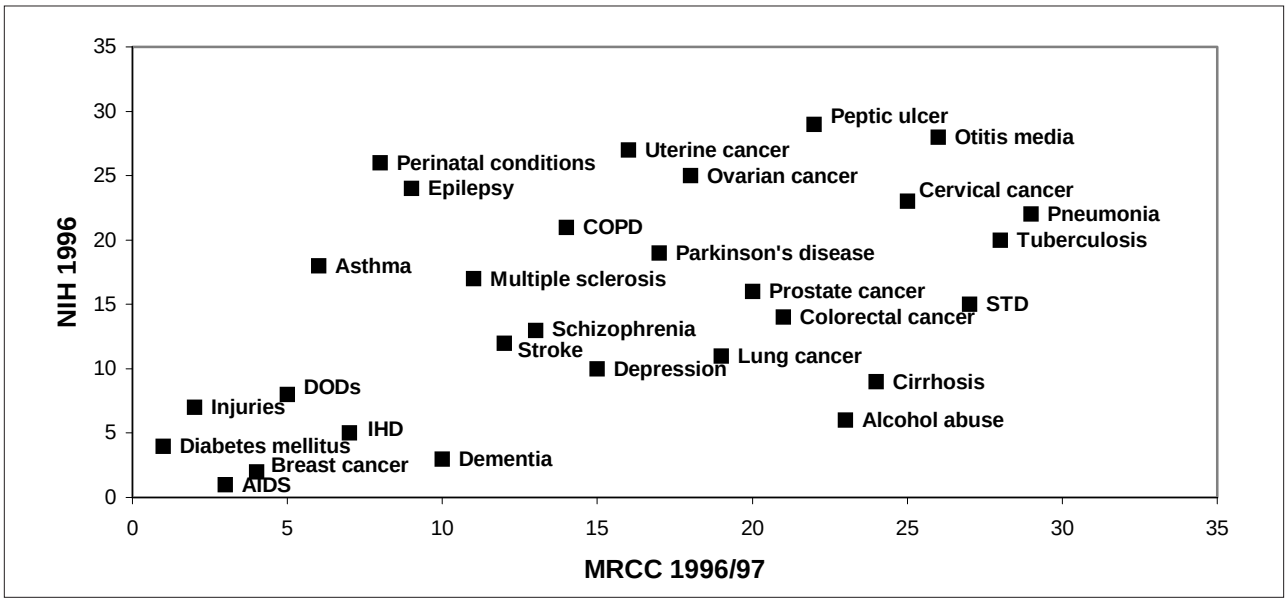

Fig. 1: A point graph with each of the disease categories positioned according to their 1996/97 Medical Research Council of Canada (MRCC) funding rank on the x axis and their 1996 National Institutes of Health (NIH) funding rank on the y axis. STD = sexually-transmitted disease, COPD = chronic obstructive pulmonary disease.

would be systematic differences in computerized searches between our group and that reported by Gross and associates. Our search strategy was adapted to MRCC database particularities, and a key word search was done when the MRCC classification table was not sufficiently precise or complete for our purpose. Gross and associates adapted their search to the NIH database and classification system. Their searching strategy was, therefore, different from ours, and comparison may be biased. The presence, direction and importance of such confounders are very difficult to assess, but significant correlation between disease-specific NIH and MRCC funding is an argument against the presence of a strong confounding effect.

One of the mandates of the MRCC is to "facilitate the return of the social and economic benefits of health research to Canadians." It could be argued that the only way to do this is to pursue a maximal cost:benefit ratio. Therefore, criteria for research grant attribution should be founded solely on the basis of measurable burden-of-disease parameters. The downside of this policy is that diseases affecting a very small proportion of the population or diseases whose burden is very hard to measure are at a disadvantage. It is usually well accepted that a small portion of research and nonresearch budgets should be attributed to such disease categories. Therefore, the accepted cost–benefit line is curved to include certain diseases with low cost:benefit ratios. The data presented in this study were not designed to detect the variations induced by such diseases but to measure the overall tendency, which should and has been strongly influenced by objective burden-of-disease parameters.

Conclusions

Disease-specific MRCC grants in the past 5 years have not been independent of some of the usual burden-of-disease parameters. Disability-adjusted life-years and prevalence were the parameters that were significantly correlated with the disease-specific amounts of MRCC grants. A statistically significant correlation was observed between disease-specific grants awarded by the MRCC and the NIH.

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Reprint requests to: Dr. Jacques LeLorier, Centre de recherche, Centre Hospitalier de l'Université de Montréal, Pavillon Hôtel-Dieu, 3850 rue Saint-Urbain, Montréal QC H2W 1T8; fax 514 843-2774, jacques.le.lorier@umontreal.ca