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Using Onomastics to Inform Diversity Initiatives: Race, Gender, and Names in Academic Radiology in Canada

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Abstract

In multiracial societies, the diversity of names in the workforce may reflect racial inclusivity. There is scant data on racial representation among Canadian physicians, prompting our analysis of naming diversity. We profiled the race and gender demographics of the names of physicians in Canadian academic radiology departments. Further, we devised a structured classification methodology using a commercial artificial intelligence and naming database to classify 1,727 names according to national origin and gender. The names were retrieved from faculty websites. A Z-test of proportions was used to compare radiologists' name demographics to demographics from the 2016 Canadian census. In close agreement with much of the literature on gender demographics, 31.99% of names were classified as female. Names that were classified as belonging to Indigenous, Black, Latin American, and Filipino name-bearers were underrepresented. Names classified as belonging to the following groups were overrepresented: South Asian, Chinese, Arab, Southeast Asian, West Asian, and Korean. Names associated with White subjects in the corpus were proportionally represented for full names and overrepresented for given names. Faculty with full names classified as Southeast Asian, Korean, and Chinese often had given names that fell into the White category. The structured methodology showed high inter-rater reliability for race classifications. The racial disparities we observed mirrored those found in surveys of medical students, suggesting that the bottleneck occurs at the level of medical school admissions. Thus, onomastics can provide valuable data to diversity initiatives.

Keywords: anthroponymy, gender equity, racism, radiology, surnames, medicine, Canada

Introduction

Diversity in the medical workforce is imperative to maintaining public trust and decreasing population-level health disparities stemming from race and gender bias. The present work focuses on the diversity of names in radiology, a technical medical specialty involved in the interpretation of medical images. Prior research has documented the underrepresentation of women in North American academic radiology in various facets (e.g., leadership positions [Qamar et al. 2020], journal editorial boards [Abdellatif et al. 2019], and National Institutes of Health grants recipients [Jutras et al. 2020]). Though disparities in gender representation have been studied by several groups, the literature on racial representation in radiology is sparse. At present, there is literature on racial disparities in radiology in the United States (US) context (Betancourt et al. 2019; Chapman et al. 2014) but scant literature in the Canadian context (Lebel et al. 2020). Literature from the US highlighted Indigenous, Black, and Latin American identities as underrepresented minorities in radiology. The lack of racial demographics data prompted us to consider an onomastic approach to assessing gender and racial diversity in Canadian academic radiologists.

Names are known to affect career outcomes. There is historical evidence of name discrimination in the US. A study that considered census records of European immigrants to the US in the 1930s and 1950s found that children of European immigrants who had given names more commonly found in the US tended to have better occupational attainment, even when correcting for social class (Goldstein & Stecklov 2016). Despite progress towards racial equity, there is evidence of ongoing discrimination against names associated with minority ethnic groups (Zhao & Biernat 2017; Kang et al. 2016; Widner & Chicoine 2011) and a racial hierarchy of name discrimination (Ahmad 2020). King et al. (2006), for example, found that self-reported White male evaluators preferentially selected names they perceived to be Asian for high-ranking job placements. This study also reported that names perceived to be Black were evaluated negatively even when they appeared on strong résumés. Researchers have studied labor markets by sending employers identical résumés with differing applicant names (Kang et al. 2016; Bertrand & Mullainathan 2004; Steinpres 1999). Bertrand & Mullainathan (2004) reported that names perceived to be White received 50% more callbacks than names perceived to be Black. Similarly, Kang et al. (2016) found that résumés with ethnic characteristics removed had greater success, with callback rates increasing 80% for a name perceived to be Asian and 150% for a name perceived to be Black. The same methodology has been used to examine the effect of gender bias on the evaluation of résumés. Steinpreis et al. (1999) found that résumés with applicant names that were perceived as being male were favored over otherwise identical résumés with names perceived as belonging to female applicants. In this study, evaluators also recommended higher starting salaries and were more likely to endorse a candidate for a tenure-track position when the résumé had a name perceived to be male. These findings suggest that laypeople estimate the gender and race of names based on their own internal model of naming patterns and that names can be utilized to help identify discriminatory selection processes.

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Since names play a central role in the formation of identity (Dion 1983), the representation of a diverse array of naming patterns may reflect the inclusion of various identities. If the racial demographics of names in radiology are not similar to those of the general Canadian population, there may be discriminatory processes that preferentially select or reject individuals based on the presumed racial identity associated with their names. Similarly, the underrepresentation of names perceived as belonging to females in radiology may reflect selection processes that benefit those who identify as male. As a profession looking to represent and care for the entire population, we ought to facilitate the inclusion of a diverse array of naming patterns. In this study, we investigated the race and gender demographics of faculty members' names in academic Canadian radiology departments using a cross-sectional descriptive study.

Methods

We searched radiology department websites from the 17 medical schools in Canada to gather the names of staff physicians. We included tenure-track and non-tenure-track clinical faculty. Data was gathered between November 2020 and February 2021. In cases where only the first initial and middle name were found, we used the middle name in place of the first given name. The names were reviewed against the provincial college of physicians and surgeons website to ensure that the names matched that of a radiologist or nuclear medicine physician. We excluded faculty who were listed as non-clinical research faculty, medical physicists, professors emeritus, and physicians not practicing radiology or nuclear medicine. Ethics approval requirements were waived by our institutional review board.

The Canadian Employment Equity Act of 1995 defines visible minorities as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour" (Statistics Canada 2017a). In our work, we used the term Indigenous synonymously with the term Aboriginal. Our statistical analysis utilized the visible minority groupings defined by the Canadian Employment Equity Act. These groupings included South Asian, Chinese, Black, Filipino, Latin American, Arab, Southeast Asian, West Asian, Korean, and Japanese. We also included the groupings White and Indigenous in our analysis. These official categorizations were chosen to facilitate comparisons with Canadian census data.

Our analysis considered the gender and race association of names to be entirely socially constructed. People of different genders may take on the same name, but for our analysis a name is classified as being "female" if more women bear it than do men. Similarly, people from vastly different ethnic backgrounds may take on the same name, either due to cultural contact or sheer coincidence. Therefore, for this investigation, the classification of names by race was determined using a probabilistic methodology described later in the text.

To estimate the national origin of the medical imaging faculty using their combined given and family names (i.e., their "full names"), we used the NamSor (Carsenat 2020) software's command line interface. NamSor utilizes artificial intelligence (AI) to predict the national origin and gender of name-bearers based on full names. NamSor provided us with the first and second most likely nation of origin. Using software for this task facilitated reproducibility, decreased the amount of manual work required, and ensured the classifications were data-based. However, as NamSor only offers classifications for full names, we used the Forebears website (Forebears DMCC 2020) to determine the probable national origin and gender of given names in isolation. The Forebears website hosts a database of given and family names with information about global usage and gender distribution. Forebears claimed to be the most detailed naming database available, with over four billion names of persons living in 2014 in their corpus.

In cases where the manual reviewer disagreed with the automated estimate of name national origin, we applied a Probabilistic Selection Index (PSI) to assign the name's associated nation. The procedure used for applying the PSI can be explained using a fictitious case of a Canadian who holds the name *Marie*. The incidence of *Marie* in DR Congo in 2014 was 2.48 million and the population of DR Congo was 73.77 million, meaning that 3.36% of individuals from DR Congo had the name *Marie*. In this scenario, however, our manual reviewer believes that the bearer of the name is from France. In France, 1.71% of the population is named *Marie*. Using our automated methodology, Canadian demographics are factored in to influence the estimation of a name's origin when a name is shared by different groups. To create a mathematical entity that allows for comparison between two different potential origins, the frequency of the name in each nation is multiplied by the probability that a local is from that nation. The result is equal to the PSI [(name, nation) = p(name | nation) * p(nation | local)].

Using this formula, the PSI calculated for the case of *Marie* would be obtained in the following manner. The frequency of *Marie* in France was 1.71% and the proportion of Canadians reporting French ancestry was 13.58%. The PSI(*Marie*|France) = 0.0171 * 0.1358 = 0.00232. The frequency of Canadians reporting Congolese origins was 0.11% and the frequency of *Marie* in DR Congo was 3.37%. Therefore, the PSI(*Marie*|DR Congo) = 0.0337 * 0.0011 = 0.000037. Since the PSI(*Marie*, France) is larger than PSI(*Marie*, DR Congo), it would be inferred that a Canadian named *Marie* was more likely to be from France than DR

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Congo. The name *Marie* would therefore be assigned to France in the manual revision process used for this investigation.

To summarize, Forebears provided the initial estimate for nation of origin for given names, which was the nation where the name had the highest incidence. When our manual reviewer believed this national origin estimate was suspect, we used Forebears to identify the country with the highest PSI. For full names, we used NamSor's top pick as our initial estimate of the nation of origin. If our manual reviewer believed the full name was misclassified, we referenced the Forebears website's data on the family name and identified the country with the highest PSI.

We manually reviewed the output of NamSor and Forebears for every faculty member. The principal reviewer of race and gender classifications lived the majority of his life in two large and diverse Canadian cities and was therefore familiar with the onomastic diversity found in the urban Canadian context. To test for reviewer bias, we had a second reviewer independently classify a random sample of 100 full names and 100 given names from our database of radiologists' names. One reviewer was West Asian and the other was White. Both were men. The second reviewer was also familiar with the variety of names found in urban Canada, as he had lived the majority of his life in several Canadian cities. Statistical analyses were performed after national origins were mapped to racial groups.

NamSor software was produced by training AI against a database of names and its predictions derive from the naming patterns it learns from this training database. We corresponded with the founder of NamSor, who informed us that the underlying methodology behind NamSor involves Natural Language Processing of large databases coupled with a Naive-Bayesian classifier with additional algorithms for reinforcement learning and model validation. The precise details of the system are proprietary. In our work, we found that NamSor misclassified names when it considered countries that have large diaspora populations or have colonial influences. Forebears differs from NamSor in that Forebears is strictly a database of names without any artificial intelligence for predictive power; Forebears provides a listing of all the countries on which they have data, and they have obtained census-level data on many countries. Forebears also declares a consistent methodology for transcribing names for every country, which is necessary because many names are written in scripts besides the Latin alphabet.

Since we took data from all Canadian universities and our population of interest is constrained to academic radiologists, our database represents the entire population to within a margin of error. The final population size was comprised of 1,727 radiologists and nuclear medicine physicians. We used the Z-test of proportions to compare the racial demographics associated with the radiologists' names to the racial demographics of the Canadian population (Statistics Canada 2017b). We also used the Z-test to compare radiologists' given name demographics to their full name demographics. Cohen's kappa was calculated for the inter-rater reliability assessment. We used a two-tailed significance value of $p < 0.05$. We used Python 3.8.3 for data analysis and statistics.

Results

We found a total of 1,852 faculty from across the 17 faculties of medicine. Thirteen full names had repetitions which were removed. One hundred twelve faculty did not meet inclusion criteria. In total, 1,727 names of radiology and nuclear medicine faculty members were used for this study. There were 21 faculty members with middle names used in place of first names. From the 1,727 full names, 101 (5.85%) were re-categorized in our manual revision process. All of the statistical analyses were performed after manual revisions. Of the given names, 171 (9.91%) had their racial category re-classified in our review process. There were three given names with unknown concomitant race data. The number of given name gender revisions was 68 (3.97%). There were 41 revisions from unknown to man, 18 from unknown to woman, two from man to woman, two from woman to man, one woman case revised to unknown, and four unknown cases which remained unknown after manual review. In total, 32.81% of gender revisions led to a feminine label and 67.19% to a masculine one. There were 11 physician names with unknown gender after manual revision, leaving 1,716 gendered names. Of these names, 549 (31.99%) were feminine. The manual edits did not skew gender demographics. For our inter-rater reliability test using 100 randomly sampled full names, we found an exceptionally high degree of inter-rater reliability with a Cohen's kappa value of 0.94. Similarly, Cohen's kappa for given name race classifications was 0.90. Lastly, Cohen's kappa was high at 0.90 for gender results, which we already had demonstrated were minimally affected by manual review.

When reviewing our data, no Indigenous (0.00% vs. 4.73%, $p<0.0005$) full or given names were identified. The incidence of names classified as White was proportionally represented for full names (74.29% vs. 73.00%, $p=0.23$) and overrepresented for given names (81.67% vs. 74.29%, $p<0.0005$). Overall, visible minorities were overrepresented when considering full names (25.71% vs. 22.27%, $p<0.0005$) and

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underrepresented when considering given names (17.98% vs. 22.27%, p<0.0005). Names classified as White were similarly likely to be feminine relative to visible minority names (32.98% vs. 27.51%, p=0.069).

We analyzed visible minority subgroups. Within the classifications Black (1.45% vs. 3.48%, p<0.0005), Filipino (0.06% vs. 2.26%, p<0.0005), and Latin American (0.00% vs. 1.29%, p<0.0005), full names were underrepresented. Visible minorities that were overrepresented with respect to full names were South Asian (10.13% vs. 5.59%, p<0.0005), Chinese (5.73% vs. 4.58%, p=0.021), Arab (2.72% vs. 1.52%, p<0.0005), Southeast Asian (2.14% vs. 0.91%, p<0.0005), West Asian (1.97% vs. 0.77%, p<0.0005), and Korean (1.27% vs. 0.55%, p<0.0005). For most visible minorities, there was a drop in representation when considering given name representation relative to full name representation. This effect met statistical significance for Korean (0.12% vs. 1.27%, p<0.0005), Chinese (1.04% vs. 5.73%, p<0.0005), and Southeast Asian (1.22% vs. 2.14%, p=0.034) groups. Notably, there was increased representation of given names classified as Latin American relative to full names (0.35% vs. 0.00%, p=0.014). Other visible minorities had comparable rates of given name representation and full name representation: Arab (2.32% vs. 2.72%, p=0.45), Black (0.99% vs. 1.45%, p=0.21), South Asian (9.98% vs. 10.13%, p=0.87), West Asian (1.85% vs. 1.97%, p=0.80), and Filipino (0.23% vs. 0.06%, p=0.18). There were no names found in which given and family names mapped to different visible minorities. Note that the multiple visible minorities demographic is 0.67% of the Canadian population.

	Canada Census 2016		Radiologists' Full Names			Radiologists' Given Names		
	Count	% Pop.	Count	% Pop.	p-value vs. census	Count	% Pop.	p-value vs. full names
Total	34,460,065	100.00	1727	100.00	N/A	1724	100.00	N/A
Total visible minority	7,674,580	22.27	444	25.71	<0.0005	310	17.98	<0.0005
White	25,155,680	73.00	1283	74.29	0.23	1408	81.67	<0.0005
Indigenous	1,629,800	4.73	0	0.00	<0.0005	0	0.0	N/A
Not a visible minority	26,785,480	77.73	1283	74.29	<0.0005	1408	81.67	<0.0005
South Asian	1,924,635	5.59	175	10.13	<0.0005	172	9.98	0.87
Chinese	1,577,060	4.58	99	5.73	0.021	18	1.04	<0.0005
Black	1,198,540	3.48	25	1.45	<0.0005	17	0.99	0.21
Filipino	780,125	2.26	1	0.06	<0.0005	4	0.23	0.18
Latin American	447,325	1.29	0	0.00	<0.0005	6	0.35	0.014
Arab	523,235	1.52	47	2.72	<0.0005	40	2.32	0.45
Southeast Asian	313,260	0.91	37	2.14	<0.0005	21	1.22	0.034
West Asian	264,305	0.77	34	1.97	<0.0005	32	1.85	0.80
Korean	188,710	0.55	22	1.27	<0.0005	2	0.12	<0.0005
Japanese	92,920	0.27	4	0.23	0.76	4	0.23	1.00
Visible minority not included elsewhere	132,090	0.38	0	0.00	0.01	0	0.00	N/A
Multiple visible minorities	232,375	0.67	0	0.00	0.001	0	0.00	N/A

Table 1: Naming racial demographics data of Canadian academic radiologists

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Discussion

We found that our naming gender demographics results matched closely with data on gender demographics available in the literature (Qamar 2020; Canadian Medical Association 2019; Canadian Institute for Health Information 2019). This concurrence suggests that onomastic analyses can be unbiased predictors of gender demographics. The underrepresentation of names associated with Indigenous, Black, Latin American, and Filipino communities may reflect economic factors and the use of names shared with White groups. Conversely, the overrepresentation of given names associated with White groups may relate to shared usage with visible minorities and Indigenous people.

The largest underrepresented group in our study was women, despite recent trends towards gender parity in Canadian radiology. The National Association of Physicians published data from 2000 to 2019 describing gender demographics by specialty (Canadian Medical Association 2019). In the year 2000, 21.6% of radiologists were women and the proportion of women has risen steadily to 31.6% in 2019 (Canadian Medical Association 2019). One study on the gender demographics of Canadian academic radiologists found that women comprised 35.95% of their sample of 922 radiologists (Qamar et al. 2020). This study did not include non-tenure-track faculty and only 74% of the faculty in their investigation had gender data available. In our study, we found that 32.0% of names were associated with the female gender, which is in close agreement with the 31.6% value reported by the Canadian Medical Association (2019). Women are currently underrepresented in medicine, with one source of data from 2017 reporting that 36.2% of specialists and 45.0% of family doctors were women (Canadian Institute for Health Information 2019). Though we only considered male and female gender identities, a diverse array of gender identities exists, including non-binary and two-spirit (Matsuno & Budge 2017). The lack of onomastic data on these gender identities precluded their assessment in this study.

We believe the effect of legal name changes on our data is small. There are approximately 22,000 legal name changes in Canada per year (Andrew-Gee 2016). As a point of comparison, there are over 250,000 new immigrants per year (Statistics Canada 2016). We also considered the effect of women who take on their husband's surname. We sought to estimate an upper bound for this effect. To estimate the upper bound, we took the proportion of our cohort with names classified as female (32%) and multiplied it by the percentage of couples that were in interracial unions: 4.6% as of 2011 (Statistics Canada 2011). We, therefore, estimated that 1.5% of our cohort could be in an interracial union that would affect our results. The true magnitude of skew would be most likely smaller since we overestimated the proportion of women in civil unions where they took on their partner's name. In addition, interracial unions can negate each other's effect. For example, some White women would marry South Asian men, and conversely, some South Asian women would marry White men. The net effect of interracial unions on our demographics results would be lessened. Since the effect of women changing their names was shown to be small, it follows that the effect of name changes from same-sex civil unions and from men taking their wives' surnames is even smaller, since these cases occur less frequently.

The most common given name nationality manual revisions were from Latin American to European nations, followed by African nations to European ones (see Figure 1a). This is understandable since Canada has relatively small populations of people from Africa and Latin America, but these countries share names with European groups that form a larger portion of Canada's population (Statistics Canada 2017b). In cases where a name was shared between two different groups, the PSI was used to categorize the name into one racial category. Due to the large population sizes of Latin American and African countries, it follows that some names shared with European groups will have a higher incidence in Latin America or Africa than in Europe. For example, *Marie* is most commonly found in DR Congo, however, the use of the PSI makes clear that a Canadian named *Marie* is more likely to be from France than from DR Congo.

The most common revisions to the national origin of full names were from African nations to European ones (see Figure 1b). This is partly due to the naming demographics of Africa, the internal workings of the NamSor AI, and the demographics of Canada. There are populations in Africa of European descent. As a result, NamSor develops some propensity towards classifying names shared with Europeans to African nations.

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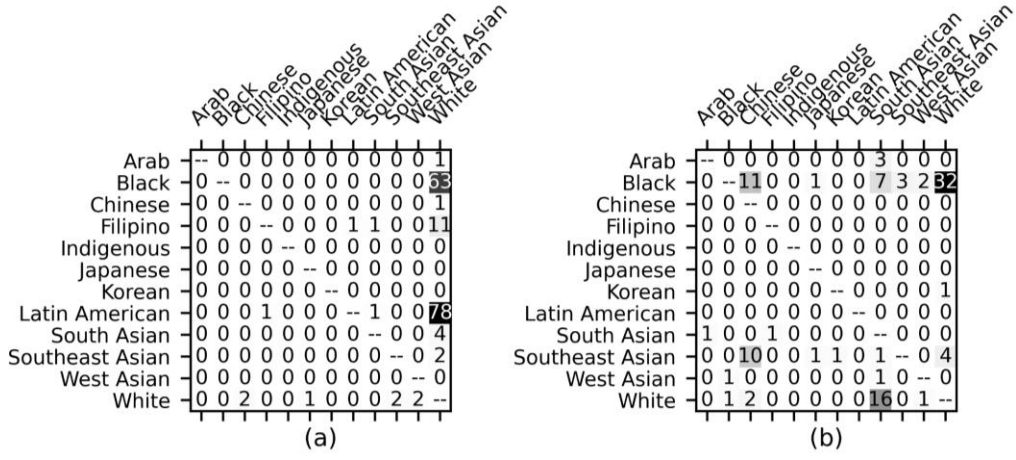

Figure 1: Heatmap of race changes to (a) given names and (b) full names during the manual review with changes made from the row race to the column race

In addition, naming in African countries has been affected by external naming patterns. The Forebears website allows users to review the most common given and family names for countries. This feature allowed us to review the most frequently given and family names in several African countries. The most common given names in South Africa was *Johannes*; in Kenya, it was *John*; in DR Congo, it was *Jean*; and in Nigeria, it was *Musa*. In Kenya and DR Congo, almost all of the most common given names were shared with European groups. South Africa had more uniquely African given naming patterns. Nigeria had a varied blend of names unique to Africa and also those shared with European and Arabic groups.

The effect of colonization on naming in native populations can be pronounced. The 2019 Kenyan census reported that ethnic Arabs, Europeans, Asians, North Americans, and South Americans comprise only 0.2% of Kenyan nationals (Kenyan National Bureau of Statistics 2019), but the most commonly given names in Kenya were those shared with English people. The most frequent Kenyan surname on Forebears was *Otieno*: a name that is highly specific to Kenya. Reviewing the names and profile pictures of prominent Kenyan radiologists on their national association's website, we found further evidence suggesting that Black Kenyans remain identifiable using their surnames (Kenyan Association of Radiologists 2021). Some surnames shared with European countries remain common in Africa as well. Since the NamSor AI makes probabilistic associations between naming patterns and nationality, the frequent use of names shared with European countries in African countries increases the probability of the AI assigning names that the manual reviewers thought were European to African countries. Lastly, since our analysis used the PSI to determine misclassifications, names shared between European and African communities would need to be disproportionately found in African individuals in order to overcome the effect of Canada's demographics.

Our manual review of the names did not identify any distinctly Indigenous names. Contemporary writers from Métis and Gwawaenuk nations have described historical and contemporary institutional mechanisms that have suppressed their traditional names (Vowel 2018; Joseph 2016). Moreover, there is evidence of a significant income inequality between Indigenous people and the rest of Canada (Wilson & Macdonald 2010). It is well-documented that medical students are typically from higher socioeconomic means (Khan et al. 2020; Fortin et al. 2018; Young et al. 2012) and this may play a role in the underrepresentation of Indigenous people in medicine. The role of socioeconomic capital in the representation of racial groups in Canadian medicine appears pronounced. Reviewing the demographics of Black Canadian immigrants, we find that they have been shifting towards economic migration as opposed to refugee migration (Houle 2020). The 2016 census was the first in which Black African recent immigrants outnumbered Afro-Caribbean recent immigrants (Houle 2020). The shifting demographics of Black Canadians may represent a shift in the socioeconomic capital of Black medical school applicants.

There were also differences identified between visible minorities. When taken as a whole, names associated with visible minorities were overrepresented in Canadian academic radiology. This finding is consistent with surveys on the demographics of medical students. One 2002 survey with an 80.2% response rate among first-year medical students found that visible minorities constituted 32.4% of the cohort, despite the fact that they represent only 20.0% of the Canadian population (Dhalla et al. 2002). A survey of medical students from 2020 found that up to 31.2% of medical students had visible minority identities (Khan et al. 2020). It has been documented that immigrants to Canada tend to be visible minorities, live in urban centers

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(Statistics Canada 2017c), and have high rates of educational attainment (Picot & Hou 2011). Moreover, second-generation Canadians tend to have greater educational attainment than third-or-higher-generation Canadians (Picot & Hou 2011). Accordingly, the children of immigrants may also be better positioned for success in medical school admissions.

Subgroup analysis of the visible minorities' data indicated that Filipino people were significantly underrepresented. Reviewing the top 100 most popular surnames in the Philippines with Forebears, we found that all the frequent surnames were ones shared with Spain—the most common surname being *dela Cruz*. During Spanish colonial rule, it was mandated that Filipino people without surnames take on Spanish surnames (Claveria 1849). It is possible that the names of Filipino radiologists either have a PSI favoring Spanish assignment, or Filipino people are a group underrepresented in radiology. Latin American names were also underrepresented. This finding may similarly reflect either their names having a PSI favoring Spanish assignment; or it may be that they are an underrepresented group in radiology. Full names classified as Chinese, Southeast Asian, and Korean had the highest rate of use in the group given names categorized as White. This result may reflect cultural and pragmatic concerns among immigrant communities in these groups (Kim 2007; Edwards 2006). A demographic survey of nine cohorts among four Canadian medical schools from 2012 reported an underrepresentation of students from Black, Indigenous, and Filipino backgrounds (Young et al. 2012). This survey aligned with our work and suggests that the racial disparities seen in the names in academic radiology may be the result of underlying racial disparities seen in medical school admissions.

It has been suggested that racial bias at the level of leadership may be a barrier to diversity in medical departments and career advancement for non-White faculty (Pololi et al. 2010; Peterson et al. 2004). One study of US American plastic surgery found that non-White chairs were correlated with significantly more non-White faculty (Smith et al. 2020). When we performed our study, there were only two radiology department heads in Canada with a non-White name, and this underrepresentation did not reach statistical significance relative to the rate of visible minority naming among academic radiologists (11.7% vs. 25.7%, p=0.187). Though the increased representation of visible minorities in leadership positions may correlate with increased representation of visible minorities among radiologists, the presence of a cause-and-effect relationship is not clear. It may be that visible minority leaders hire more visible minority staff. Another explanation might be that institutions with a higher proportion of visible minority staff are more likely to produce leaders who are from visible minorities. There were no department heads with a name classified as female. This result represented statistically significant degree of under-representation relative to female names in academic radiology (0% vs. 32.0%, p=0.005).

There is surprisingly little literature available on these issues considering the widespread use of AI name-ethnicity prediction to assess diversity. We identified one small study in which NamSor was used to assess diversity in radiation oncology (Chowdhary et al. 2020). We also found one study that considered the use of AI name-ethnicity prediction in France. This investigation examined the representation of different ethnic clusters among government officials, researchers, and other specialists (Mazières & Roth 2018). It determined that names predicted as being Arabic were underrepresented in all measured sectors whereas names predicted as being Northern European were overrepresented in government. The use of AI is not without its own ethical issues. For example, based on the nature and quality of the data with which they are trained, AI programs can develop biases. One study comparing several name-gender classifiers found that multiple classifiers, including NamSor, made greater errors when considering names thought to be Asian in comparison to names thought to be European (Santamaría & Mihaljević 2018). In our investigation, the use of a manual reviewer who considered Canadian demographics and the Forebears global database helped to mitigate AI bias, but our study was not without its own limitations.

For example, the faculty websites used for this research might not have been up-to-date. The classifications were also dependent on the quality of Forebears and NamSor products. The proprietary nature of these products made it difficult to assess them. Since the study is a population-wide census of Canadian academic radiologists' names, its findings are not generalizable to radiologists practicing outside of university-affiliated medical systems. Since immigration policy varies by country, these results cannot be extrapolated to other countries. The human assessment of national origin classifications may be also subject to implicit biases. While an alternative methodology to estimate name origins would be a survey distributed to academic radiologists in all Canadian radiology departments, this procedure would require ethics board approval at all institutions and would therefore pose a significant administrative barrier. An alternative method of conducting a survey of all academic radiologists might not have reached an adequate response rate, or provide sufficient data on the racial and gender associations of the radiologists' names—data which we view as complementary information when considering self-reported racial identity.

With regard to future work, it would be valuable to characterize the naming demographics and subjective experiences of international medical graduates. It would also be important to compare the demographics of medical trainees to those of staff physicians since the trajectory of demographics signals changes in overall demographics. Future work could also examine differences in naming representation in

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leadership roles. It is similarly suggested that subsequent studies be conducted to determine the extent to which Indigenous, Black, Latin American, and Filipino identities can enter medicine.

Summary and Conclusion

In this study, it was determined that Canada's visible minorities were nominally well represented in academic radiology, though subgroup analyses demonstrated that significant disparities were present. The structured classification methodology showed high inter-rater reliability for the racial classifications of names. The proportion of names classified as female was in close agreement with literature data on gender demographics and suggested that quantitative onomastic analyses can provide unbiased estimates of gender demographics. Our findings were also consistent with prior work on the racial demographics of Canadian medical students. Our results add to the growing body of literature which suggest that racial disparities in radiology stem from disparities in medical school admissions.

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