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Sex-Based Disparities in the Hourly Earnings of Surgeons in the Fee-for-Service System in Ontario, Canada

Fahima Dossa, MD; Andrea N. Simpson, MD, MSc; Rinku Sutradhar, PhD; David R. Urbach, MD, MSc; George Tomlinson, PhD; Allan S. Detsky, MD, PhD, CM; Nancy N. Baxter, MD, PhD

IMPORTANCE Sex-based income disparities are well documented in medicine and most pronounced in surgery. These disparities are commonly attributed to differences in hours worked. One proposed solution to close the earnings gap is a fee-for-service payment system, which is theoretically free of bias. However, it is unclear whether a sex-based earnings gap persists in a fee-for-service system when earnings are measured on the basis of hours worked.

OBJECTIVE To determine whether male and female surgeons have similar earnings for each hour spent operating in a fee-for-service system.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional, population-based study used administrative databases from a fee-for-service, single-payer health system in Ontario, Canada. Surgeons who submitted claims for surgical procedures performed between January 1, 2014, and December 31, 2016, were included. Data analysis took place from February 2018 to December 2018.

EXPOSURES Surgeon sex.

MAIN OUTCOMES AND MEASURES This study compared earnings per hour spent operating between male and female surgeons and earnings stratified by surgical specialty in a matched analysis. We explored factors potentially associated with earnings disparities, including differences in procedure duration and type between male and female surgeons and hourly earnings for procedures performed primarily on male vs female patients.

RESULTS We identified 1 508 471 surgical procedures claimed by 3275 surgeons. Female surgeons had practiced fewer years than male surgeons (median [interquartile range], 8.4 [2.9-16.6] vs 14.7 [5.9-25.7] years; $P < .001$), and the largest proportion of female surgeons practiced gynecology (400 of 819 female surgeons [48.8%]). Hourly earnings for female surgeons were 24% lower than for male surgeons (relative rate, 0.76 [95% CI, 0.74-0.79]; $P < .001$). This disparity persisted after adjusting for specialty and in matched analysis stratified by specialty, with the largest mean differences in cardiothoracic surgery (in US dollars: $59.64/hour) and orthopedic surgery ($55.45/hour). There were no differences in time taken by male and female surgeons to perform common procedures; however, female surgeons more commonly performed procedures with the lowest hourly earnings.

CONCLUSIONS AND RELEVANCE Even within a fee-for-service system, male and female surgeons do not have equal earnings for equal hours spent working, suggesting that the opportunity to perform the most lucrative surgical procedures is greater for men than women. These findings call for a comprehensive analysis of drivers of sex-based earning disparities, including referral patterns, and highlight the need for systems-level solutions.

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Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Nancy N. Baxter, MD, PhD, Division of General Surgery, St. Michael's Hospital, 30 Bond St, 040-16 Cardinal Carter Wing, Toronto, ON M5B 1W8, Canada (nancy.baxter@unityhealth.to).

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Female physicians earn less than male physicians; in the United States, the disparity in adjusted annual salary is estimated at 20%.[1,2] One contributor to the sex-based income disparity is that fewer women enter highly remunerative specialties,[3,4] such as surgery. In the United States, women account for 34% of physicians but only 12% of surgeons.[5] Similarly, in Canada, women make up 42% of all physicians but only 19% of surgeons.[6] Other explanations include differences in practice type,[2] hours worked,[2] parental status,[7] years in practice,[8] career advancement,[8-10] and leadership roles attained.[7,11] If personal lifestyle or practice choices were the only causes of earning disparities, male and female physicians performing similar work and working similar hours would have equal earnings. However, studies of US physicians estimate 37% to 39% of the salary disparity in medicine is unexplained by personal or practice factors.[1,7]

Previous studies exploring earning disparities rely on survey data or US Medicare claims[12,13] (which are only part of practice for most physicians), focus on annual salary among academic physicians[1] (where rank and research productivity contribute to differences), or use proxies for part-time work. In a fee-for-service system, physician reimbursement is directly linked to services rendered. For surgeons, who have the largest sex-based salary differences,[1] mean earnings from time spent operating in fee-for-service systems depend on speed of practice and types of procedures performed (the procedure mix). Similar to the relative value unit (RVU) system in the United States,[14] procedural fees in Ontario, Canada, were developed to reflect the time, skill, and effort required to provide services and are updated with clinician input.[15] However, in both the US and Ontario systems, some procedures are unexpectedly more lucrative than others. For example, although primary total knee arthroplasty is less complex and typically requires less effort and skill than revision total knee arthroplasty,[16] because of the RVUs assigned to these procedures, an orthopedic surgeon in the United States performing only primary total knee arthroplasty would make US $137 008.70 more than a surgeon performing only revisional procedures.[17]

In theory, fee-for-service systems should be less susceptible to sex bias and less likely to result in sex-based differences in earnings compared with salary-based systems. However, because the process by which fees are allocated to procedures is subjective, and the way that more lucrative procedures are distributed within specialties may be prone to referral bias, sex disparities in earnings can occur even in fee-for-service systems. For surgeons, time spent operating is a highly reimbursed aspect of practice; differences in reimbursement for this time is a potential source of large earning disparities. The objective of this study was to explore sex-based disparities in fee-for-service earnings of surgeons. Specifically, we determined whether male and female surgeons have similar earnings for equal time spent operating and assessed potential drivers of earnings disparities.

Key Points

Question Do male and female surgeons in Ontario, Canada, have equal earnings for each hour they spend operating in a fee-for-service system?

Findings In this cross-sectional study of 3275 surgeons, female surgeons earned 24% less per hour spent operating than male surgeons did and more commonly performed the least remunerative surgical procedures. In some specialties, earnings differences were more than $53 ($70 Canadian) per hour.

Meaning Previous studies have attributed a portion of the sex-based earnings gap to differences in hours worked; however, this study demonstrates that even when equal hours are worked, female surgeons earn less than male surgeons and have fewer opportunities to perform the most lucrative surgical procedures.

Methods

Overview

This study was approved by the St. Michael's Hospital research ethics board. We designed a cross-sectional study of surgeons' earnings for operative procedures performed in Ontario, Canada, from January 1, 2014, to December 31, 2016, using linked, population-based administrative databases housed at ICES, an independent, nonprofit research institute with a legal status under Ontario's health information privacy law that allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement. All data were deidentified prior to analysis. This study was designed to address 3 questions: (1) do earnings per hour of operating time differ between male and female surgeons, (2) are there differences in hourly earnings between male and female surgeons within surgical specialties, and (3) what factors explain sex-based differences in earnings?

Context

Ontario has a publicly funded, single-payer health care system. Surgeons are paid for services they provide to patients covered under the Ontario Health Insurance Plan (OHIP) according to the OHIP Schedule of Benefits[18]; hence, payer mix is not a factor. We used encrypted patient and clinician identifiers to link administrative databases. We extracted patient and clinician characteristics and records of surgical procedures performed.

Surgical Procedures

To be reimbursed, surgeons submit claims to OHIP. Procedure claims are associated with specific fee codes that can be used to identify procedure type, date, and amount claimed. Patients undergoing multiple procedures have more than 1 unique fee code claimed on the same date (eg, bowel resection and hernia repair). Add-on codes are claims garnering additional reimbursement, reflecting case complexity (eg, extensive lysis of adhesions).

We used procedure fee codes to identify hospital-based, elective surgical procedures performed on adults by surgeons practicing general surgery, neurosurgery, orthopedic surgery, plastic surgery, cardiothoracic surgery, gynecology, ophthalmology, otolaryngology, and urology within fee-for-service models. We excluded after-hours and emergency procedures because we aimed to explore reimbursement for elective cases, in which differences in procedure mix might be

Table 1. Surgeon and Patient Baseline Characteristics Before and After Hard Matching on Specialty and Years in Practice and Propensity-Score Matching[a]

Characteristic	Before Matching			After Matching		
	Surgeons, No. (%)		Standardized Differences	Surgeons, No. (%)		Standardized Differences
	Male (n = 2456)	Female (n = 819)		Male (n = 576)	Female (n = 576)	
Surgeon characteristics						
Age, median (IQR), y	49 (40-59)	42 (36-50)	0.62	45 (37-53)	43 (37-51)	0.10
Years in practice, median (IQR)	14.7 (5.9-25.7)	8.4 (2.9-16.6)	0.56	9.7 (3.3-18.5)	9.6 (3.3-18.0)	0.00
Specialty						
General surgery	543 (22.1)	162 (19.8)		154 (26.7)	154 (26.7)	
Neurosurgery[b]	67 (2.4-2.9)	≤5 (≤0.6)		NA	NA	
Orthopedic surgery	525 (21.4)	42 (5.1)		41 (7.1)	41 (7.1)	
Plastic surgery	161 (6.6)	58 (7.1)		52 (9.0)	52 (9.0)	
Cardiothoracic surgery	114 (4.6)	17 (2.1)	−1.00	16 (2.8)	16 (2.8)	0.00
Gynecology	306 (12.5)	400 (48.8)		189 (32.8)	189 (32.8)	
Ophthalmology	297 (12.1)	71 (8.7)		64 (11.1)	64 (11.1)	
Otolaryngology	195 (7.9)	51 (6.2)		47 (8.2)	47 (8.2)	
Urology[b]	248 (9.8-10.2)	10-20 (1.2-2.4)		13 (2.3)	13 (2.3)	
Hospital type						
Teaching	861 (35.1)	301 (36.8)		194 (33.7)	207 (35.9)	
Nonteaching	1275 (51.9)	386 (47.1)	−0.11	296 (51.4)	281 (48.8)	−0.05
Missing	320 (13.0)	132 (16.1)		86 (14.9)	88 (15.3)	
Patient characteristics						
Age, mean (SD), y	55.4 (10.1)	49.7 (10.2)	0.55	51.4 (9.9)	52.1 (9.9)	−0.06
Aggregated Diagnosis Group						
<10	669 511 (73.2)	131 696 (74.4)	0.18	137 916 (74.7)	104 051 (73.3)	−0.02
≥10	244 761 (26.8)	45 348 (25.6)		46 806 (25.3)	37 756 (26.6)	
American Society of Anesthesiologists category						
<3	507 158 (55.5)	113 605 (64.2)	0.43	116 493 (63.1)	87 639 (61.8)	0.10
≥3	407 114 (44.5)	63 439 (35.8)		68 229 (36.9)	54 168 (38.2)	
BMI						
≤40	853 351 (93.3)	165 884 (93.7)	−0.03	172 177 (93.2)	133 300 (94.0)	0.05
>40	60 921 (6.7)	11 160 (6.3)		12 545 (6.8)	8507 (6.0)	
Marginalization index, mean (SD)	3.0 (0.3)	3.0 (0.3)	−0.01	3.0 (0.3)	3.0 (0.3)	0.12

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); IQR, interquartile range; NA, not applicable.

[a] Propensity matching was on physician age, practice type, mean patient age, proportion of patients with Aggregated Diagnosis Group scores of 10 or more, proportion of patients with American Society of Anesthesiologists level of 3 or more, proportion of patients with body mass index greater than 40, and mean patient marginalization per the Marginalization Index.

[b] Exact values are not expressed because of small cell sizes.

present. We excluded bronchoscopy, gastrointestinal endoscopy, and cystoscopy to limit our analyses to earnings for operative procedures. We excluded surgeons paid by non-fee-for-service funding plans.

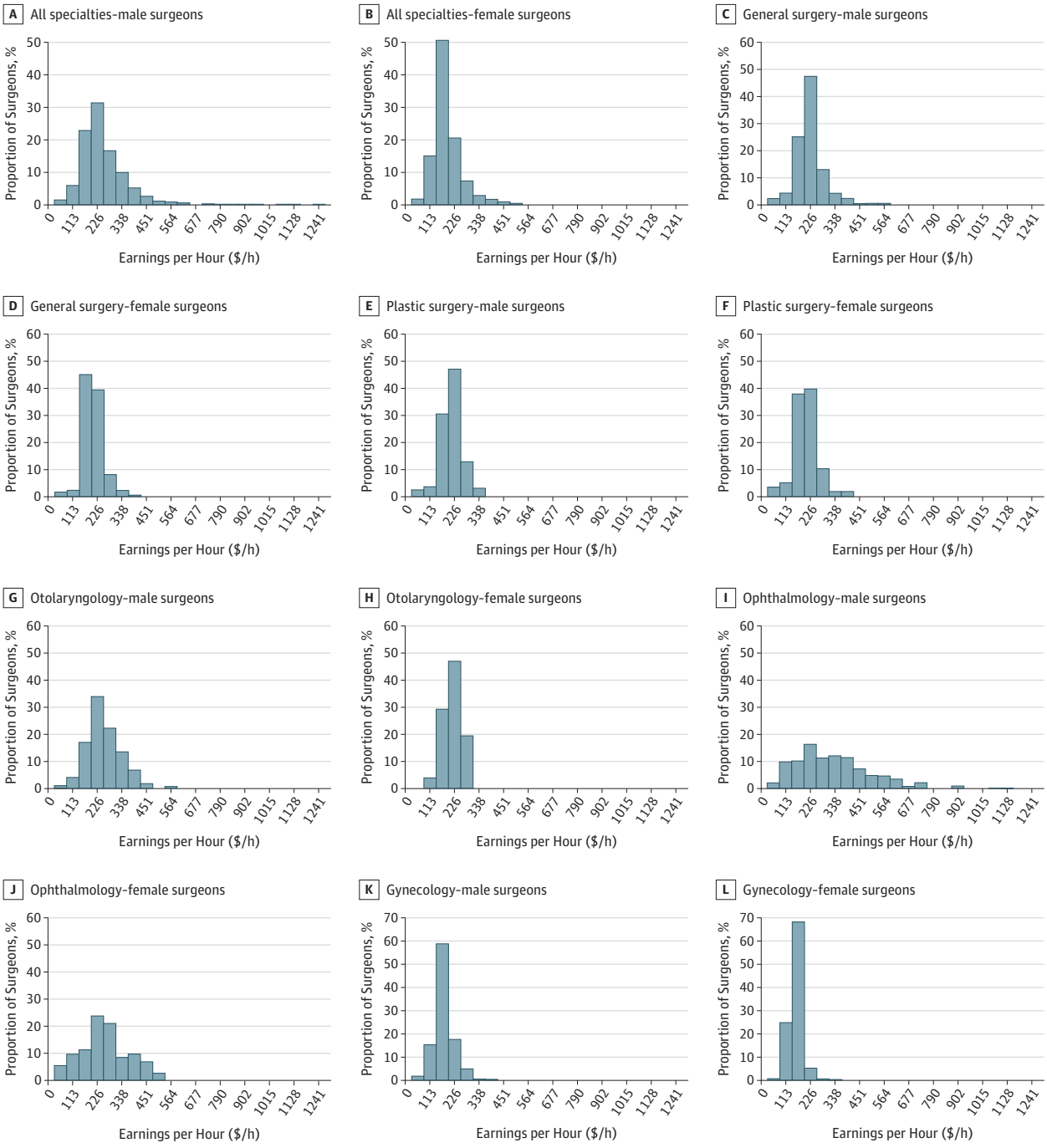
Procedure Duration

Anesthesiologists submit claims to OHIP using codes reflecting procedure type and duration, expressed in service units. Total service units for each procedure include setup units (defined by OHIP) and duration units in 15-minute increments. We used a previously validated algorithm based on total service units to estimate procedure duration within 15 minutes.[19] We excluded cases where procedure duration could not be determined (<15 minutes) or when we could not match surgeon and anesthesiologist claims. We also excluded procedures performed out of a hospital (because most are performed without anesthesia, and this limited the ability to calculate procedure duration) and procedures performed by 2 primary surgeons (because procedure duration could not be attributed to a single surgeon).

Outcomes

The primary outcome was earnings per hour of operating time. A single surgery could have multiple procedure codes and add-on codes billed. If multiple procedures were claimed for the same patient on the same date, the claim resulting in the highest reimbursement was considered the primary procedure; other procedures were considered secondary. We calculated total earnings per surgery by summing up the amount paid to the surgeon for all primary and secondary procedures and add-on codes billed with identical patient identifiers and an identical service date. Total earnings per surgeon across the study period were then calculated. Duration of each surgery in 15-minute increments was determined based on service units

Figure 1. Distributions of Earnings per Hour in the Unmatched Cohort



Specialties in all but A and B were chosen based on a count of more than 50 female surgeons in that specialty. Monetary values are rounded to the nearest US dollar.

billed by anesthesiology for the procedure and then summed up across all surgeries performed by individual surgeons to determine total operative time in hours per surgeon. For each surgeon, total earnings were divided by total operative time to determine earnings per hour of operating time.

To explore the hypotheses that earning differences are explained by differences in procedure mix, patient sex (because female surgeons treat proportionally more women, and previous studies[20,21] have demonstrated lower reimbursements for similar gynecologic vs urologic procedures; eTable 1 in the Supplement) or duration of procedures, we calculated mean earnings for each primary procedure. This was done by identifying all surgeries that included the primary procedure, then calculating mean total earnings per surgery, including associated secondary and add-on procedures. Mean procedure time in hours was calculated as the mean duration of these procedures.

Table 2. Multivariable Analysis of the Association Between Surgeon Sex and Earnings per Hour of Operating Time

Characteristic	Adjusted Relative Rate (95% CI)	*P* Value
Surgeon sex		
Male	1 [Reference]	NA
Female	0.76 (0.74-0.79)	<.001
Surgeon years in practice	1.00 (1.00-1.00)	.53
Hospital type		
Teaching	1 [Reference]	NA
Nonteaching	1.01 (0.98-1.04)	.41
Patient age[a]	1.01 (1.01-1.01)	<.001
Proportion of patients by characteristic		
Aggregated Diagnosis Group ≥10	1.00 (0.89-1.13)	.95
American Society of Anesthesiologists ≥3	1.53 (1.42-1.64)	<.001
BMI >40	0.87 (0.71-1.07)	.19
Marginalization[a]	0.95 (0.91-1.01)	.09

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); NA, not applicable.

[a] Modeled as mean values for each surgeon based on all operations performed across the study period.

Covariates

We selected a priori physician-level covariates associated with level of expertise and patient-level covariates that could influence case complexity and thereby earnings. Physician-level variables measured on the procedure date included age (continuous), sex (male or female), specialty, years in practice (continuous), and practice type (teaching vs nonteaching hospital). Patient-level variables on the procedure date included age (continuous), sex, morbid obesity (defined as a body mass index [calculated as weight in kilograms divided by height in meters squared] >40), marginalization, and comorbidities. Marginalization was expressed using the Ontario Marginalization Index (1, least marginalized; 5, most marginalized), a validated measure considering material deprivation, residential instability, ethnic concentration, and dependency based on geographic location of residence.[22] Comorbidities were categorized according to the Aggregated Diagnosis Groups (ADGs) of the Johns Hopkins ACG System version 10.0 (Johns Hopkins University).[23] This system uses inpatient and ambulatory health care data to identify medical conditions and assigns an ADG value based on the duration, severity, and causative mechanism of the condition; diagnostic certainty and specialty care involvement; and American Society of Anesthesiologists (ASA) physical status classification categories[24] (eTable 2 in the Supplement).

Statistical Analyses

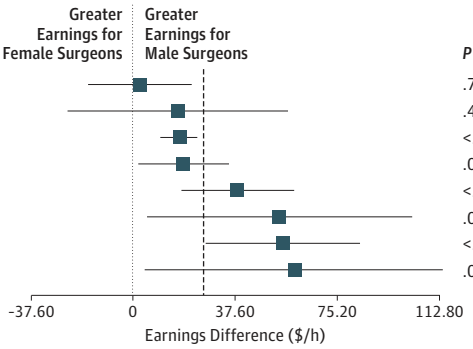
Baseline physician and patient characteristics and unadjusted hourly earnings were compared between male and female surgeons using independent-sample *t* tests and Mann-Whitney *U* tests for continuous variables and χ^2 tests for proportions. To determine the adjusted association between surgeon sex and hourly earnings, we first constructed a surgeon-level multivariable Poisson model with total earnings per surgeon as the outcome and the natural logarithm of the total operative time in hours as the offset. Covariates included physician age, practice type, years in practice, mean patient age (continuous), proportion of patients with high levels of comorbidity (ADG ≥10), proportion of patients with ASA level greater than or equal to 3, proportion of patients with a body mass index greater than 40, and mean patient marginalization (continuous). Because of collinearity with years in practice, physician age was removed from the model. We included specialty as a covariate in a second analysis to separately explore its influence on earnings. Because of significant overdispersion of the Poisson model (eTable 3 in the Supplement), we used a more conservative negative binomial model with identical covariates for the final analysis.[25]

Next, we explored within-specialty hourly earnings differences. To ensure similar distributions of patient and clinician characteristics between male and female surgeons within specialties, we undertook a matched-pair analysis using a combination of hard and propensity-score matching. We used a multivariable logistic regression model to generate propensity scores. Covariates included in the propensity-score model were mean patient age (continuous), proportion of patients with ADGs greater than or equal to 10, proportion of patients with ASA levels of 3 or more, proportion of patients with a body mass index of 40, mean patient marginalization, physician age, and practice type. Male and female surgeons were hard matched on specialty and years in practice and propensity-score matched using a 1:1 nearest-neighbor matching algorithm with no replacement and a caliper width of 0.2 of the SD of the logit of the propensity score. We compared standardized differences among baseline variables before and after matching. We also compared absolute differences in earnings per hour of operative time within each specialty using paired *t* tests. Neurosurgeons were excluded because there were 5 women or fewer in this specialty.

We investigated 3 factors potentially associated with differences in hourly earnings. We determined whether male and female surgeons varied in the time they took to perform identical procedures. To do so, we identified the 25 most commonly performed procedures within each specialty (225 procedures total) and constructed a patient-level negative binomial model with number of 15-minute service units billed as the outcome. The model was fit using generalized estimating equations to account for clustering by procedure. Second, because female surgeons treat proportionally more women, we investigated whether differences in hourly earnings could be attributed to lower reimbursements for procedures more often performed on female patients. For each of the 225 procedures, we calculated the proportion of female patients. We then constructed a surgery-level multivariable negative binomial regression model of mean earnings for each primary procedure and the proportion of female patients, using the natural logarithm of mean procedure duration as the offset and adjusting for patient-level covariates. Lastly, we examined whether differences in procedure mix existed between male and female surgeons. For the 200 most commonly performed procedures across all specialties, we constructed a linear regression model to evaluate the association between hourly earnings and the proportion of women performing each procedure.

Figure 2. Mean Differences in Hourly Earnings Between Matched Male and Female Surgeons Within Each Specialty

Specialty	Mean Difference ($/h)	95% CI	P Value
Plastic surgery	2.68	-16.70 to 22.08	.78
Urology	16.52	-24.53 to 57.57	.40
Gynecology	17.24	9.77 to 24.71	<.001
General surgery	18.52	1.06 to 35.98	.04
Otolaryngology	38.53	17.28 to 59.79	<.001
Ophthalmology	54.06	4.90 to 103.25	.03
Orthopedic surgery	55.45	26.40 to 84.45	<.001
Cardiothoracic surgery	59.64	4.36 to 114.91	.04



The vertical dotted line represents mean hourly earnings difference between matched male and female surgeons ($25.98 per hour). Square boxes represent mean values; horizontal bars represent 95% CIs.

Statistical analyses were 2-sided, with a *P* value <.05 considered statistically significant. Analyses were performed using SAS software version 9.4 (SAS Institute). Monetary values were calculated in Canadian dollars and are presented in US dollars, at an exchange rate of CaD $1 to US $0.752033.[26]

Results

Procedures and Surgeons

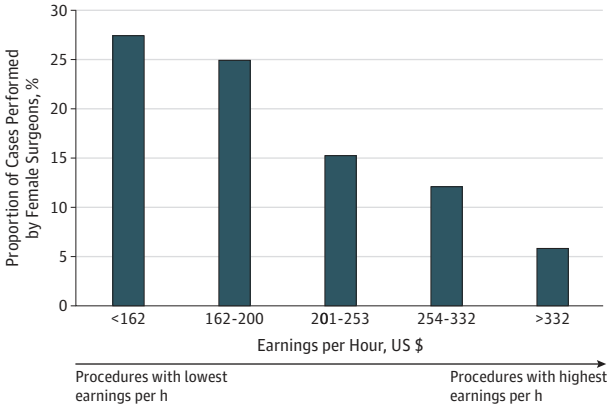
We identified 2 200 998 elective hospital-based surgical procedures performed between January 1, 2014, and December 31, 2016; these included 1 508 471 procedures (1 091 309 primary and 417 162 secondary) and 692 527 add-ons performed by 3275 surgeons (eFigure 1 in the Supplement). Male surgeons were older than female surgeons (median [interquartile range (IQR)] age, 49 [40-59] years vs 42 [36-50] years; *P* < .001) and had been in practice longer (median [IQR], 14.7 [5.9-25.7] years vs 8.4 [2.9-16.6] years; *P* < .001; **Table 1**). The most common specialties were general surgery (543 of 2456 [22.1%]) and orthopedic surgery (525 of 2456 [21.4%]) among male surgeons and gynecology (400 of 819 [48.8%]) and general surgery (162 of 819 [19.8%]) among female surgeons. Female patients made up a greater proportion of patients treated by female surgeons (141 471 of 177 044 patients [79.9%]) vs male surgeons (489 320 of 914 269 [53.5%]; *P* < .001).

Surgeon Sex and Hourly Earnings

The distributions of earnings per hour are presented in **Figure 1**. Unadjusted mean hourly earnings (in US dollars) were $226.26 per hour and $161.38 per hour for male and female surgeons, respectively (difference: $64.88 per hour; *P* < .001). Of all male surgeons, 515 (21.0%) earned $150 per hour or less, compared with 433 female surgeons (52.9%; *P* < .001). In multivariable analyses, female surgeons had lower hourly earnings than male surgeons (relative rate, 0.76 [95% CI, 0.74-0.79]; **Table 2**), even after adjusting for surgical specialty (relative rate, 0.86 [95% CI, 0.83-0.89]; eTable 4 in the Supplement).

We successfully matched 576 pairs of female and male surgeons (Table 1; eFigure 2 in the Supplement). Among matched surgeons, overall mean hourly earnings were $197.52 per hour for male surgeons and $171.55 per hour for female surgeons (difference: $25.98 per hour; *P* < .001). Male surgeons earned significantly more per hour than female surgeons in gynecology (difference: $17.24 per hour; *P* < .001), general surgery ($18.52 per hour; *P* = .04), otolaryngology ($38.53 per hour; *P* < .001), ophthalmology ($54.06 per hour; *P* = .03), orthopedic surgery ($55.45 per hour; *P* < .001), and cardiothoracic surgery ($59.64 per hour; *P* = .04; **Figure 2**).

Figure 3. Proportion of Operations Performed by Female Surgeons for the 200 Most Common Procedures Across All Specialties



Procedures are grouped into quintiles based on mean hourly earnings per procedure among male surgeons and ordered from lowest to highest earnings per hour. As hourly earnings increase, the proportion of females performing these procedures decreases. Monetary values are rounded to the nearest US dollar.

Patient Sex and Hourly Earnings

We identified 1720 unique primary procedures performed during the study period. For the 225 most common procedures, we found no association between the proportion of female patients and mean procedure earnings (eTable 5 in the Supplement).

Surgeon Sex and Procedure Duration

For the 25 most common procedures in each specialty, a significant difference in procedure duration between male and female surgeons was found only in plastic surgery (relative risk, 1.07 [95% CI, 1.02-1.13]; eTable 6 in the Supplement), in which a mean of 1 additional 15-minute increment was billed for procedures performed by female surgeons. No significant differences in procedure duration were found for other specialties.

Procedure Mix

When the 200 most common procedures across all specialties were divided into quintiles based on earnings per hour, we found that women performed 44 463 of the 162 131 least remunerative procedures (27.4%) but only 10 568 of the 182 092 most remunerative procedures (5.8%) (**Figure 3**). As hourly earnings increased, the proportion of female surgeons performing the procedure decreased (β = −0.03 [SE, 0.006]; $P < .001$).

Discussion

In this study of 3275 surgeons and 1.5 million surgical procedures, we found that female surgeons earned 76% per hour of operative time of the male surgeons' earnings; this disparity persisted after adjustment for surgical specialty. After matching for potential explanatory factors, we found statistically significant differences in earnings between male and female surgeons for most specialties, ranging from $17.24 per hour in gynecology to more than $50 per hour in ophthalmology, orthopedics, and cardiothoracic surgery.

The explanation for sex-based differences in earnings is likely multifactorial. Women were most highly represented in surgical specialties with the lowest earnings, such as gynecology. Although this may be partly explained by individual preferences, the predominance of women in these specialties is also influenced by the hidden curriculum, whereby female trainees are implicitly and explicitly discouraged from entering particular disciplines.[27,28] Given that earnings depend on claims submitted, the disparity may also be associated with less aggressive billing behaviors (ie, fewer premiums billed) of female surgeons. However, this does not explain the entire disparity; when we examined the highest paid primary procedures, women were performing fewer of these procedures than men. It is more likely that women are choosing or being driven toward not only the less remunerative specialties, but also the less lucrative procedures within specialties. Among the 200 most common procedures across all specialties, female surgeons performed procedures with lower reimbursement more frequently than male surgeons.

Two previous studies using US Medicare data attributed sex-based disparities primarily to differences in practice patterns[12,13]; however, neither examined the contribution of procedure mix to operative earnings. Another study evaluating reimbursement for hip and knee arthroplasties found no difference between sexes in reimbursements.[29] However, by limiting analyses to 2 procedures, the authors again could not examine procedure mix. In contrast, this study evaluates most elective surgical procedures and, using conservative modeling strategies, systematically examines potential drivers of the earnings disparity, including procedure mix. Differences in procedure mix may reflect surgeon preferences but strongly suggest biased referral patterns. A recent study of referral practices showed implicit sex-based bias influenced referrals to US surgeons, disadvantaging female surgeons.[30] This bias is present despite work showing that female surgeons in Ontario have equivalent outcomes as and, in some cases, better outcomes than male surgeons.[31]

While this study examines the fee-for-service system in 1 jurisdiction, similar findings may affect women in the US RVU system[32,33] and other systems where physicians' reimbursement is reliant partly or entirely on procedure mix. This is supported by recent work that compared 50 similar gynecologic and urologic procedures and demonstrated higher RVUs or reimbursement for procedures performed on male patients than female patients.[20] Given that women surgeons are more highly represented in gynecology than urology, the finding that female surgeons more commonly perform procedures with the lowest reimbursements has important implications; this may be a major source of income disparities for women surgeons in the United States.

Limitations

Although this study is a comprehensive assessment of surgeon earnings per hour of operating time, there are limitations. We identified few women in some specialties, limiting power to identify differences. Procedure time was estimated in 15-minute blocks; however, a more precise estimate is unlikely to have affected results. The analysis includes only earnings for operative practice, and it is possible, although unlikely, that women earn more per hour than men in clinic or for nonsurgical procedures, such as endoscopy. We did not evaluate total annual compensation for operative hours worked, because this depends on both operating time allocation and time dedicated to nonoperative duties (eg, research, teaching, administration, other clinical work). Earnings differences may have been underestimated, particularly for specialties where surgeons also work in private practice (and this may explain why we did not find earning differences among plastic surgeons). We excluded out-of-hospital procedures because most are performed without anesthesia, precluding an estimate of hourly rate. Finally, although the analysis provides insight into some mechanisms underlying disparities, other sources (eg, preferences, lifestyle-associated decisions) remain unexplored.

Conclusions

Our findings demonstrate that, in Ontario, male surgeons have more opportunities to perform the most lucrative surgical procedures than female surgeons. This disparity was present in almost all surgical specialties. While prior literature has attributed disparities to women's working styles,[12,34] this study demonstrates that female surgeons make less money per hour and perform fewer of the most lucrative procedures than male surgeons. Therefore, increasing hours worked will not close the earnings gap. Although this analysis is limited to time spent operating, it shows that female surgeons are considerably disadvantaged in one of the most profitable aspects of their work.

In conclusion, even within a fee-for-service system, for equal time worked, female surgeons earn less than male surgeons and more commonly perform procedures with the lowest hourly earnings. These findings call for a comprehensive analysis of the drivers of sex-based earning disparities, including referral patterns, and highlight the need for systems-level solutions.

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Author Affiliations: Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada (Dossa, Urbach, Baxter); Department of Surgery, St Michael's Hospital, Toronto, Ontario, Canada (Dossa, Baxter); Institute of Health Policy, Management, and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada (Dossa, Simpson, Sutradhar, Urbach, Detsky, Baxter); Division of Minimally Invasive Gynecologic Surgery, University of Toronto, Toronto, Ontario, Canada (Simpson); Department of Obstetrics and Gynecology, St Michael's Hospital, Toronto, Ontario, Canada (Simpson); ICES, Toronto, Ontario, Canada (Sutradhar, Urbach, Baxter); Department of Surgery, University Health Network, Toronto, Ontario, Canada (Urbach); Department of Epidemiology and Biostatistics, University Health Network, University of Toronto, Toronto, Ontario, Canada (Tomlinson); Department of Medicine, University of Toronto, Toronto, Ontario, Canada (Tomlinson, Detsky); Department of Medicine, Mount Sinai Hospital, University Health Network, Toronto, Ontario, Canada (Detsky).

Author Contributions: Dr Dossa had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Dossa, Simpson, Sutradhar, Detsky, Baxter.
Acquisition, analysis, or interpretation of data: Dossa, Sutradhar, Urbach, Tomlinson, Detsky, Baxter.
Drafting of the manuscript: Dossa, Simpson, Sutradhar, Baxter.
Critical revision of the manuscript for important intellectual content: Dossa, Sutradhar, Urbach, Tomlinson, Detsky, Baxter.
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Invited Commentary

Procedure Mix—The Path to Pay Equity

Lindsay E. Kuo, MD, MBA; Rachel R. Kelz, MD, MSCE, MBA

Over the past several years, increasing attention has been given to the issue of workforce sex disparities, both within medicine at large and surgery specifically. Inequalities exist between male and female surgeons in academic advancement, recognition of achievements, and compensation.[1-3]

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As a profession, surgeons need to move beyond awareness of the problem of sex disparities and toward a deeper understanding of causes.

To this end, Dossa et al[4] examined the hourly wage of male and female surgeons across 9 surgical specialties in the single-payer fee-for-service system in Ontario, Canada, from 2014 through 2016. Male surgeons earned significantly more per hour than female surgeons, a difference that persisted after adjusting for surgical specialty. After performing a matched-pairs analysis to account for age and time in practice, the differences in hourly wage per specialty ranged from $17.25 per hour in gynecology to $59.68 per hour in cardiothoracic surgery.

The observed difference in earnings between male and female surgeons could not be attributed to a difference in payer mix or predetermined surgeon salaries. Further, the difference cannot be attributed to different operative times for performing the same surgeries, because longer operative times (15 minutes) were only noted for female plastic surgeons. Instead, the wage gap appears to be attributable to differences in procedure mix. While female surgeons performed 27.4% of the procedures that paid the least, they performed just 5.8% of the procedures that paid the most.

What causes the difference in procedure mix between male and female surgeons? Individual preference likely does not account for systematic disparity described by Dossa et al.[4] Instead, implicit bias by referring physicians likely plays a substantial role.[5] Internal referrals within a division or department also contribute: a senior surgeon sends a junior female surgeon ostensibly easier cases associated with lower compensation while sending a junior male surgeon more challenging cases associated with higher compensation. Although the intention behind these actions may not be malicious, the unintended consequence is downstream disparity in earnings. Importantly, in prior studies,[6] male and female surgeons achieved similar patient outcomes, suggesting that there is no difference in surgical ability between the sexes—and thus no reason for disparate referral patterns.

Individual departments and practices must begin to examine procedure mix among their surgeons. Sex-based disparities in procedure mix can be reduced and eliminated through deliberate action and attention paid to external and internal referrals. Female and male surgeons work equally hard for their patients and achieve equivalent results, and they should be compensated equally.

ARTICLE INFORMATION

Author Affiliations: Lewis Katz School of Medicine, Temple University, Philadelphia, Pennsylvania (Kuo); Perelman School of Medicine, University of Pennsylvania, Philadelphia (Kelz).

Corresponding Author: Rachel R. Kelz, MD, MSCE, MBA, Perelman School of Medicine, Department of Surgery, University of Pennsylvania, 3400 Spruce St, 4 Silverstein Pavilion, Philadelphia, PA 19004 (rachel.kelz@uphs.upenn.edu).

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