


BMJ Open The gender wage gap among medical specialists: a quantitative analysis of the hourly pay of publicly employed senior doctors in New Zealand

Isabelle Sin,^{1,2} Bronwyn Bruce-Brand,³ Charlotte Nesta Louise Chambers ⁴

To cite: Sin I, Bruce-Brand B, Chambers CNL. The gender wage gap among medical specialists: a quantitative analysis of the hourly pay of publicly employed senior doctors in New Zealand. *BMJ Open* 2021;**11**:e045214. doi:10.1136/bmjopen-2020-045214

► Prepublication history and additional material for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-045214>).

Received 28 September 2020
Revised 08 March 2021
Accepted 15 March 2021



© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Motu Economic and Public Policy Research, Wellington, New Zealand

²Te Pūnaha Matatini Centre of Research Excellence, Auckland, New Zealand

³Wellington, New Zealand

⁴Policy and Research, Association of Salaried Medical Specialists, Wellington, New Zealand

Correspondence to

Dr Charlotte Nesta Louise Chambers; cc@asms.nz

ABSTRACT

Objectives To estimate the gender gap in hourly wages earned by medical specialists in their main jobs after controlling for age, number of hours worked and medical specialty.

Design Observational using governmental administrative and survey data.

Setting New Zealand public employed medical workforce.

Participants 3510 medical specialists who were employed for wages or a salary in a medical capacity by a New Zealand district health board (DHB) at the time of the March 2013 census, whose census responses on hours worked were complete and can be matched to tax records of earnings to construct hourly earnings.

Main outcome measures Hourly earnings in the DHB job calculated from usual weekly hours worked reported in the census and wage or salary earnings paid in the month recorded in administrative tax data.

Results In their DHB employment, female specialists earned on average 12.5% lower hourly wages than their male counterparts of the same age, in the same specialty, who work the same number of hours (95% CI 9.9% to 15.1%). Adding controls for a wide range of personal and work characteristics decreased the estimated gap only slightly to 11.2% (95% CI 8.6% to 13.8%). At most, 4.5 percentage points can be explained by gender differences in experience at the same age.

Conclusions Male specialists earn a large and statistically significant premium over their female colleagues. Age, specialty and hours of work do not appear to drive these wage gaps. These findings suggest that employment agreements that specify minimum wages for each level of experience, and progression through these levels, are insufficient to eliminate gender wage gaps between similar men and women with the same experience.

INTRODUCTION

Despite their growing presence in medical workforces, women continue to earn significantly less than their male doctor counterparts.^{1 2} International research suggests wage gaps between male and female doctors ranging from 13% in the USA³ to 17%–23% in Australia⁴ and 34% in the UK.⁵ The prevalence of gender pay gaps in medicine has been ascribed to the tendency for female

Strengths and limitations of this study

- Strengths include being the first study to examine the extent and drivers of gender wage gaps among senior doctors, using actual earnings data in a nationwide study.
- It fills a gap in scant literature on doctor remuneration in relation to collective employment agreements or public health sector employment alone.
- The research uses data from tax records, so it is not subject to self-reporting bias.
- Limitations include the use of cross-sectional data from 2013 so the wage growth of individual specialists over time cannot be analysed.
- Hourly wages are generated by combining data from two sources, a process that introduces some level of error into the data.

doctors to self-select into lower paid medical specialities,⁶ to work fewer hours than their male counterparts⁷ and to take time out of the paid workforce for maternity leave.⁸ Other research suggests a pay gap as a consequence of the ‘breadwinner effect’, where men with children earn more than those without, and the ‘carer effect’, where women with children earn less than those without.^{9 10} In addition, research suggests women in medicine face subtle gender-based discrimination¹¹ and are less likely to negotiate on salary offers, all of which may contribute to the persistence of a wage gap.¹² In this research, we quantify the gender wage gap for senior doctors in the public health system in New Zealand.

According to the Organisation for Economic Co-operation and Development (OECD), New Zealand’s 2018 gender wage gap in median earnings for all full-time employees was 7.9%, considerably below the 12.8% on average for OECD countries.¹³ Statistics New Zealand (using different methodology) calculated a slightly higher gender wage gap of 9.2% in the same year.¹⁴ Neither



estimate controls for any individual characteristics such as occupation, age or level of education. Other recent New Zealand studies that estimate the wage gap between similar men and women find it remains sizeable even when controlling for characteristics of the individuals and their jobs.^{15–17} Significantly, these studies find a larger wage gap between men and women who are more skilled or higher up the earnings distribution.

New Zealand has a large public health system that provides free or subsidised health and disability services to the New Zealand population, mainly funded through general taxation. The majority of funds managed by the Ministry of Health are allocated to 20 district health boards (DHBs). Publicly employed medical staff are employees of and paid by the DHBs. Instead of or in addition to DHB employment, medical specialists may work in the private health system, which operates alongside the public health system and caters to those with private insurance, among others. The majority of general practitioners operate in a private practice capacity.

The medical profession is not typical of high-skill professions in New Zealand. In particular, unionisation among senior doctors (referred to hereafter as medical specialists) working in the public health system is very high, and the pay and conditions negotiated by their union, the Association of Salaried Medical Specialists (ASMS), in their Multi Employer Collective Agreement (MECA) with the 20 DHBs are extended to publicly employed specialists who are not union members, subject to a few conditions. Among other conditions of employment, the MECA specifies minimum salary levels for medical specialists at each level of experience and progression through them. Specialists are assigned to a step when they take up employment with a DHB. This could be the first step if they are newly qualified or could be negotiated between the employee and employer based on past experience and qualification level. In the experience of ASMS, overwhelmingly members advance a step each year until they reach the top step. Those on approved unpaid leave for up to a period of 6 months, or on parental leave for up to 12 months, are still eligible for these regular pay increases.

In addition to base pay, the MECA specifies that a DHB may pay additional ‘recruitment and retention benefits’ to address actual or potential recruitment problems and ‘special contributions benefits’ to recognise special skills or responsibilities.¹⁸ Furthermore, it should be noted the MECA sets out minimum pay and conditions for specialists, and individuals or groups may negotiate more favourable additional conditions with their employer. Nonetheless, the salary minima for each step and regular progression through the steps are expected to reduce the scope for a wage gap to arise between equally skilled and experienced men and women who are employed as medical specialists by DHBs.

Little is currently known as to the extent and drivers of gender wage gaps among medical specialists specifically. Furthermore, to the best of the authors’ knowledge,

there are no studies examining doctor remuneration in relation to collective employment agreements or public health sector employment. The aims of this research, which revises existing work,¹⁹ are to quantify the gender wage gap for medical specialists in New Zealand public health system employment using actual earnings data, with a focus on controlling for factors such as experience, hours worked and medical specialty, which are commonly ascribed factors for gender wage gaps.

In this context, we explain our approach to data and analysis before comparing raw characteristics and outcomes of men and women.

METHODS

The main data source used in this research was the Integrated Data Infrastructure (IDI) managed by Statistics New Zealand. The IDI brings together administrative data for the full population of New Zealand and selected survey data from a wide range of sources and links records for individuals between different data sources. Specifically, this research used the 2013 Census of Population and Dwellings, which provides data on occupation (specialty) and weekly hours worked along with a multitude of other personal and employer characteristics, and the employer monthly schedule (EMS) from Inland Revenue, which records wages paid each month by each employer to each employee in the country.ⁱ This combination of data sources provided the most recent and complete data available at the time of writing on earnings and hours worked for the full population of DHB-employed medical specialists. In addition, we use the Ministry of Education’s tertiary qualifications data to construct the dates individuals received their medical degrees.

Participants

The conceptual population of interest was medical specialists who were employed for wages or a salary in a medical capacity by a DHB at the time of the March 2013 census. This included individuals for whom this DHB job was the only or main job and those for whom it was a secondary job. The sample from this population was all individuals who stated their occupation in the census as a medical specialty (see online supplemental appendix 2: included specialties) and who were shown in the EMS to have received wages from a DHB in March 2013, the month of the census. However, individuals who met these criteria but were observed in the Ministry of Education data to receive a Bachelor of Medicine and Bachelor of Surgery (medical degree) from a New Zealand institution after the year 2013 were excluded. This yielded an overall sample of 4041 specialists.ⁱⁱ The full construction

ⁱThe most recent 2018 census data were deemed unsuitable due to a high non-response rate and resulting poor data quality caused by the shift to an online survey.

ⁱⁱThese numbers, and all other population counts in this paper, have been randomly rounded to base 3 for confidentiality reasons, as required by Statistics New Zealand.

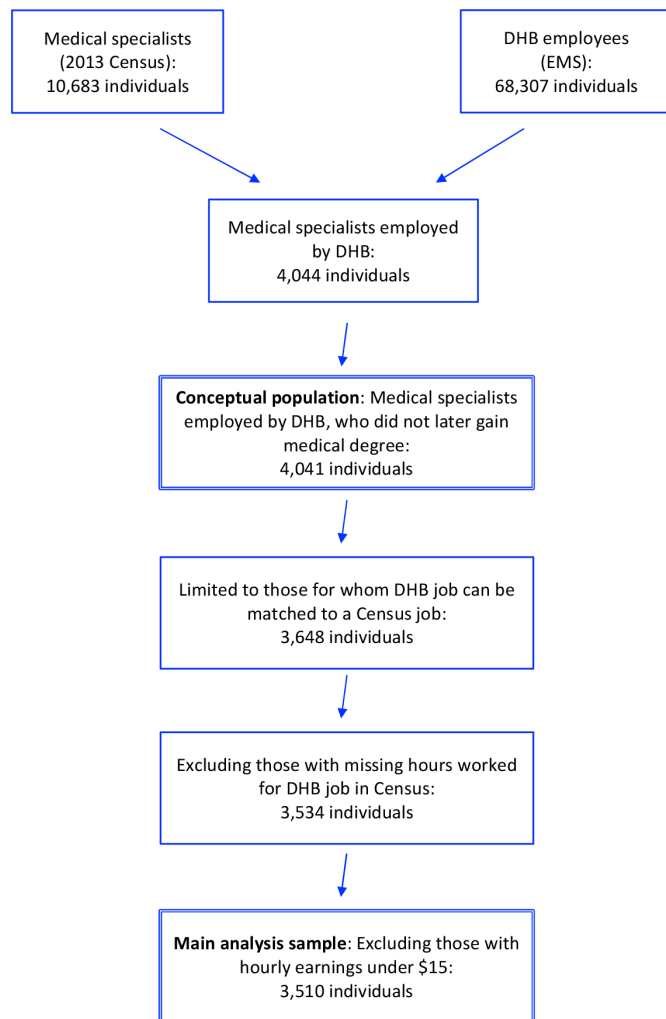


Figure 1 Sample construction. DHB, district health board; EMS, employer monthly schedule.

of the analysis data set and the sample size at each stage are shown in [figure 1](#).

Whether individuals were international medical graduates (IMGs) was determined by analysis of Ministry of Education Qualifications data and census data on country of birth and years in New Zealand. Individuals were classed as IMGs if they did not receive a medical degree in New Zealand (since 1994, the year data on degrees granted began), were born overseas and migrated to New Zealand when aged 24 years or older. The rationale for this cut-off was that 24 years old is both the modal and median age for receiving a medical degree in New Zealand since 1994.

Patient and public involvement

No patients were involved.

Measures

The primary wage outcome of interest was individual hourly wage earnings in the individual's largest DHB job. This variable was calculated as monthly wages paid by the highest paying DHB employer divided by weekly hours worked in the DHB job reported in the census, times

(7/31). This calculation was complicated by the necessity of matching census jobs (the source of hours worked) with EMS jobs (the source of earnings) and the way hours worked is asked in the census. The census collects most information about the 'main job', defined as the job in which the individual worked the greatest number of hours. Statistics New Zealand processes the information and provides data on industry and sector of employer for main job. Industry and sector are also available for the employer in the EMS data. We applied several criteria sequentially to determine which EMS job (if any) was the main census job. First, we considered an EMS job to be the main job if it fully matched the main census job in terms of sector and detailed industry. If two or more EMS jobs met this criterion, the one paying the highest wages was considered the main job. Second, if the sector matched and the industry matched at only the two-digit level (aggregate industry classification), we defined the EMS job as the main census job. Multiple matches were dealt with by choosing the EMS job with higher wages. If no EMS jobs matched the sector and aggregate industry of the main census job, no EMS job was allocated as the main census job. Inability to identify the main job in the EMS data caused the loss of some observations from our hourly wage data set.

The census collects two hours worked variables: hours worked in main job and hours worked in all other jobs.ⁱⁱⁱ If the DHB job is the individual's main job or only job other than their main job, the answers to these questions allowed us to identify how many hours they work for the DHB. We lost from the hourly wage data set observations for individuals with three or more jobs for whom the DHB job was not their main job. We also lost observations where the individual did not complete the census questions on hours worked, and we dropped the small number of cases for which our calculation yielded wages below \$15 an hour.^{iv} This process resulted in 3510 observations of hourly wages in main DHB job, which amounted to 86.9% of the desired population.

RESULTS

[Table 1](#) presents descriptive statistics separately by gender for the work outcomes and main controls used in the regression analysis.

[Figure 2](#) displays the change in mean hourly wage in the DHB job and its 95% CI, unadjusted for any characteristics, by age for each gender for medical specialists. For both genders, hourly wages increase gradually to the age of about 30 years, increase rapidly over the next 10

ⁱⁱⁱIn both cases, the wording of the question is 'How many hours, to the nearest hour, do you usually work each week?'. We can only speculate on how individual specialists interpret this question, but it seems plausible that many will include on call hours in the number they report.

^{iv}Our preferred estimate of the overall gender wage gap for specialists falls from 12.5% to 11.6% when we instead use a cut-off of \$20. However, using this larger cut-off disproportionately drops (low-paid) women from the sample, so is likely to underestimate the gender wage gap.

**Table 1** Means and SD of outcomes of interest and control variables for the sample of male and female specialists with non-missing DHB hourly wage earnings

	Male		Female	
	Mean	SD	Mean	SD
Outcomes				
Monthly wage earnings in DHB job	\$15870	\$7381	\$11920	\$6078
Weekly hours worked in DHB job	44.6	13.9	42.0	14.6
Hourly wage in DHB job	\$87.8	\$54.8	\$71.6	\$61.2
Main controls				
Female	0		1	
Age	46.1	11.6	41.2	11.1
Hours worked in DHB job				
30 or fewer	0.161		0.240	
31–40	0.229		0.261	
41–50	0.338		0.247	
51–60	0.208		0.189	
Over 60	0.064		0.062	
Observations		2211		1299
Additional controls				
Number of children in family				
0 children	0.422		0.534	
1 child	0.164		0.143	
2 or more children	0.414		0.321	
Highest qualification				
Bachelor's degree	0.341		0.409	
Honours or master's degree	0.342		0.378	
Doctorate	0.317		0.214	
Foreign born	0.557		0.558	
Overseas trained (IMG)	0.421		0.380	
Any non-European ethnicity	0.259		0.233	
Asian ethnicity	0.185		0.166	
Social marital status				
Currently partnered	0.886		0.727	
Previously partnered	0.029		0.055	
Never partnered	0.084		0.219	
Self-employed	0.429		0.197	
Hours worked in other jobs				
0	0.638		0.817	
1–10	0.142		0.093	
11–25	0.123		0.059	
26–40	0.066		0.021	
Over 40	0.031		0.010	
Observations		2139		1263

DHB, district health board; IMG, international medical graduate.

or 15 years, and then flatten out. This is roughly the age at which specialists who gain their medical degrees at age 24 years might be expected to reach the top salary step

specified in the MECA that was in force in March 2013. The difference in average hourly earnings between men and women is small and fairly constant until age 40 years,

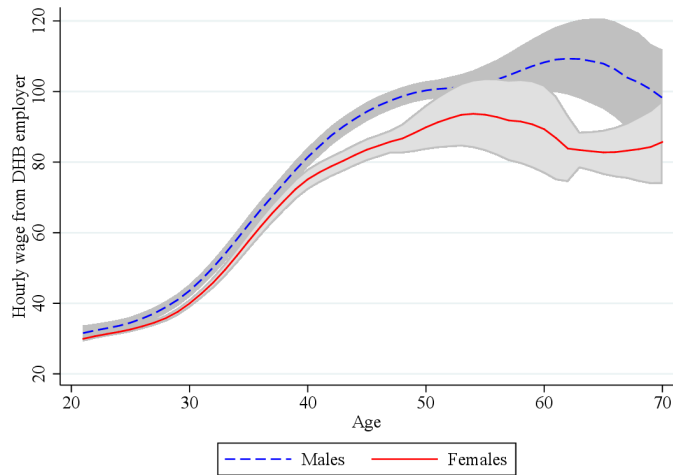


Figure 2 Raw hourly wage in main DHB job by age and gender. DHB, district health board.

but beyond that increases rapidly to give men a wage advantage over women.

Gender difference in hourly wage

The gender wage gap in hourly wage earned in specialists' main DHB jobs was calculated by running an ordinary least squares regression at the individual level of the log of hourly earnings on a dummy variable for female and progressively adding in other controls. Column 1 of [table 2](#) presents the results of the most basic regression, which includes no additional controls. The coefficient of -0.237 on female, which is highly statistically significant, shows that in her DHB job, the average female specialist earned an hourly wage that is 21.1% lower than the hourly wage of the average male specialist.^v Column 2 flexibly controls for age using an age spline of order 4, which closely fits the shape of the age–earnings relationship shown in [figure 2](#), and compares the earnings of men and women of the same age. Here the coefficient on age falls to -0.106 , indicating women earn hourly wages 10.1% lower than men of the same age. The existence of a gender wage gap between medical specialists of the same age suggests the lower hourly wages of female specialists relative to male specialists is not the result of the female specialists being younger on average.

Column 3 of the table adds fixed effects for specialty to test the extent to which the gender wage gap is driven by women selecting into lower paying specialties. Here the coefficient on female falls slightly to -0.097 , indicating that women earn an average of 9.2% less each hour than men of the same age in the same specialty. Comparison with column 2 shows that women have only a weak tendency to select into lower paying specialties and suggests this mechanism plays a very minor role in the overall gender wage gap.

^v $1 - \exp(-0.237) = 21.1\%$.

Another potential explanation for the gender wage gap is that female specialists are more likely to work part time, and part-time employees might earn lower hourly wages than full-time employees. Column 4 of [table 2](#) adds controls for weekly hours worked in the DHB job (30 or fewer hours, 31–40 hours, 51–60 hours and over 60 hours, with 41–50 hours as the omitted category). It thus compares men and women of the same age, in the same specialty, who work the same number of hours each week in their DHB job. The coefficients on the hours worked variables reveal that, on average over men and women, hourly wage is substantially higher among those who work fewer hours each week in their DHB job. Furthermore, controlling for hours worked substantially increases the coefficient on female from -0.097 to -0.134 , indicating women's hourly wages lag those of men of the same age, in the same specialty, who work the same hours in their DHB job by 12.5%. This estimate is statistically significant at the 1% level and has a 95% CI ranging from 9.9% to 15.1%.

To account for the possibility that some DHBs pay higher wages than others and women are more likely to work for low-wage DHBs, column 5 of [table 2](#) adds DHB fixed effects and compares similar men and women who work for the same DHB. The gender wage gap here is 12.8%, virtually unchanged.

Finally, column 6 of the table adds controls for a range of additional personal characteristics to test the extent to which the gender wage gap can be explained by observable characteristics that might justify differential wages. Controls are included for number of children, highest qualification, being foreign born, having trained overseas, ethnicity, social marital status and number of hours worked in non-DHB jobs each week. The 108 observations with missing values for any of the included covariates are dropped here and in subsequent tables.

In this specification, the gender wage gap falls to 11.2% and remains highly significant. To verify our treatment of missing values does not drive this result, we alternatively impute all missing covariates to minimise the estimated gender wage gap and impute all missing covariates to maximise the gap. With these extreme imputations, our estimate of the wage gap varies only from 11.0% to 11.4%. We thus conclude treatment of the missing values has little bearing on the estimated gender wage gap. The regression also shows working in additional non-DHB jobs was strongly associated with higher hourly earnings in the DHB job. For instance, those who work 1–10 hours each week in other jobs earn 9.5% higher wages than those who work only for the DHB, and those who work 26–40 hours in other jobs earn 13.9% higher wages. Having a doctorate is also associated with significantly higher earnings.

Online supplemental appendix 1 replicates columns 2, 5 and 6 of [table 2](#) separately for medical specialties, surgical specialties, general practice and other specialties.

Table 2 Main estimates of gender wage gap**Dependent variable: hourly wages in main DHB job (ln)**

	1	2	3	4	5	6
Female	-0.237‡ (0.019)	-0.106‡ (0.015)	-0.097‡ (0.015)	-0.134‡ (0.015)	-0.137‡ (0.015)	-0.119‡ (0.015)
Hours worked in main DHB job (omitted 41–50 hours)						
30 or fewer				0.230‡ (0.024)	0.232‡ (0.024)	0.197‡ (0.027)
31–40				0.044‡ (0.017)	0.045‡ (0.017)	0.041‡ (0.017)
51–60				-0.149‡ (0.015)	-0.151‡ (0.015)	-0.141‡ (0.016)
Over 60				-0.288‡ (0.022)	-0.291‡ (0.022)	-0.278‡ (0.022)
One-child family						0.015 (0.021)
Family with two or more children						0.004 (0.019)
Highest qualification (omitted bachelor's degree)						
Honours and master's						0.029* (0.016)
Doctorate						0.090‡ (0.018)
Foreign born						-0.012 (0.020)
Overseas trained						0.041‡ (0.021)
Reports any non-European ethnicity						-0.021 (0.024)
Reports Asian ethnicity						-0.002 (0.027)
Social marital status (omitted non-partnered, never married or in civil union)						
Partnered						0.014 (0.021)
Previously partnered						-0.064 (0.047)
Self-employed						-0.010 (0.020)
Hours worked in other jobs (omitted 0 hours)						
1–10						0.091‡ (0.022)
11–25						0.032 (0.028)
26–40						0.130‡ (0.049)
Over 40						0.233‡ (0.069)

Continued

Table 2 Continued

Dependent variable: hourly wages in main DHB job (ln)	1	2	3	4	5	6
Flexible age controls	No	Yes	Yes	Yes	Yes	Yes
Specialty fixed effects	No	No	Yes	Yes	Yes	Yes
DHB fixed effects	No	No	No	No	Yes	Yes
R ²	0.045	0.458	0.480	0.535	0.540	0.552
Observations	3510	3510	3510	3510	3510	3402

Each column presents results from an ordinary least squares regression with dependent variable log hourly wage in main DHB job. Flexible age controls are an age spline of order 4. All observation counts have been randomly rounded to base 3. Robust SEs are in parentheses

*P<0.10.

†P<0.05.

‡P<0.01.

DHB, district health board; OLS, ordinary least squares.

It shows the gender wage gap is present and of comparable size for each of these specialties.

The above analysis controls for age as a proxy for experience. However, women may have less experience than men at the same age if they entered the profession later or had more gaps in their employment, such as for raising children. For specialists who received their medical degrees in New Zealand in 1994 or later, we explored this possibility in [table 3](#). The baseline wage gap for this sample between men and women of the same age, controlling for other major covariates, was 7.1% (column 1). Instead comparing those who received medical degrees in the same year reduced the wage gap to 6.3% (column 2). Additionally accounting for estimated time away from work for parental responsibilities reduced the gender wage gap to 5.6% (column 3).^{vi} Thus, for specialists who were qualified in New Zealand in 1994 or later, accounting for differences in age entering the profession and average breaks for parental responsibilities explains only 21.0% of the gender wage gap.

Another way that experience might affect earnings is through longer working weeks, which enable a specialist to accumulate experience more quickly. In column 4 of [table 3](#), we add controls for number of weekly hours worked in other jobs, reducing the gender wage gap to 4.6% (significant at the 5% level). Overall, 35.6% of the gender wage gap for this subpopulation, or 2.5 percentage points of a total of 7.1, can be explained by these past and contemporaneous experience controls. Assuming differential experience at the same age had the same explanatory power in the full sample, this would mean

it explained 4.5 percentage points of the overall 12.5% gender wage gap.

Heterogeneity in the gender wage gap

In [table 4](#), we present the results of regressions that test how the within-specialty gender wage gap between similar men and women differs with personal characteristics. Column 1 shows the gap increases with age, from 4.3% for ages under 30 years up to 14.6% for ages 40 years and over. Column 2 shows the gap is larger among specialists who work fewer hours each week in their DHB job, at 20.5% among those who work up to 30 hours per week, compared with only 4.2% for those who work over 60 hours. Column 3 suggests the gap might be smaller among specialists who work more hours in other jobs, but statistical power is too low to be confident of this relationship. Column 4 shows the gap rises with number of children in the household, from 8.1% between men and women with no children in their families to 15.4% between those in families with two or more children. Column 5 shows there is no significant difference in the gender wage gap for specialists who trained overseas or recent migrants (who arrived in New Zealand no more than a year before the 2013 census). Column 6 shows the gap is lower among more qualified specialists, falling from 15.6% for those with bachelor's degrees only to 6.3% for those with doctorates.

DISCUSSION

This study reports on the first analysis into the gender gap in hourly wages of a senior medical workforce across an entire country, based on actual earnings data. It extends existing research by examining associations between hourly wages and age, experience, medical specialty and other demographic factors such as numbers of children and ethnicity. It proposes an approach to measuring and estimating gender pay gaps and further contributes to the wider literature by considering the role of multiemployer collective agreements as a factor that should limit the opportunity for gender pay gaps to arise.

^{vi}Separate regressions (not shown) estimated that having a child reduces the months in which a female doctor works by 5 months on average, whereas male doctors do not decrease their months worked when they have children. An adjusted years of experience variable was constructed that was equal to years since gaining medical degree for men, and years since gaining medical degree minus 5 months for every live child given birth to for women. Column 3 controls flexibly for this adjusted experience measure.

Table 3 Gender wage gap varying controls for experience**Dependent variable: hourly wages in main DHB job (ln)**

	Trained in NZ since 1994			
	1	2	3	4
Female	-0.074‡ (0.026)	-0.065† (0.025)	-0.058† (0.025)	-0.047† (0.023)
Hours worked in main DHB job (omitted 41–50 hours)				
30 or fewer	0.376‡ (0.086)	0.337‡ (0.092)	0.345‡ (0.091)	0.323‡ (0.084)
31–40	0.158‡ (0.044)	0.137‡ (0.040)	0.135‡ (0.039)	0.140‡ (0.039)
51–60	-0.205‡ (0.025)	-0.167‡ (0.023)	-0.166‡ (0.023)	-0.160‡ (0.023)
Over 60	-0.324‡ (0.027)	-0.271‡ (0.025)	-0.270‡ (0.025)	-0.267‡ (0.025)
Highest qualification (omitted bachelor's degree/level 7)				
Honours and master's	0.016 (0.025)	0.011 (0.024)	0.013 (0.024)	0.005 (0.025)
Doctorate	0.141‡ (0.046)	0.077* (0.044)	0.066 (0.044)	0.076* (0.044)
Age spline	Yes	No	No	No
Years since qual spline	No	Yes	No	No
Years since qual with child adjustment spline	No	No	Yes	Yes
Hours worked in other jobs controls	No	No	No	Yes
Specialty fixed effects	Yes	Yes	Yes	Yes
R ²	0.623	0.656	0.660	0.670
Observations	759	759	759	759

Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. The sample is specialists who gained their medical degree in New Zealand (NZ) in 1994 or more recently. All observation counts have been randomly rounded to base 3. Robust SEs are in parentheses.

*P<0.10.

†P<0.05.

‡P<0.01.

DHB, district health board.

Despite specialist salaries being specified by the MECA negotiated by the ASMS, we find male specialists earn a large and statistically significant premium over their female colleagues. When we compare male and female specialists of the same age, in the same specialty, who work the same number of hours each week, we find female specialists earn on average 12.5% lower hourly wages than their male counterparts in their DHB employment, with a 95% CI of 9.9% to 15.1%. Adding controls for a wide range of personal and work characteristics decreases the estimated gap only slightly to 11.2%.

The wage gap increases with age from 4.3% for under 30s to 14.6% for those aged 40 years and over. For specialists without children, there is a smaller but still statistically significant gender wage gap of 8.1%. This gender wage gap rises to 12.1% for those with one child and to 15.4% for those with two or more children. Given that

the average female medical specialist reduces her lifetime months worked by on average 5 months for each child she bears, and the ASMS MECA specifies that specialists on parental leave for up to 12 months will receive the same regular pay increases as they would receive were they not on leave, these wage gaps for parents cannot be explained by time out of the paid workforce for parental leave alone. As well as being larger among parents, we find the wage gap increases with age and is higher for specialists who work fewer hours each week in their DHB job, reaching 20.5% for those who work 30 or fewer hours and is lower for specialists with higher degrees, falling to 6.3% among those with doctorates.

These wage gaps flexibly account for age, so are not driven by female specialists being younger on average than male specialists. They compare men and women in the same specialty, so are not driven by female specialists

Table 4 Heterogeneity of gender wage gap

Dependent variable: hourly wages in main DHB job (ln)

	1	2	3	4	5	6
Female	-0.106‡ (0.031)	-0.072‡ (0.022)	-0.123‡ (0.016)	-0.084‡ (0.020)	-0.117‡ (0.019)	-0.170‡ (0.025)
Aged under 30 years * female	0.062* (0.038)					
Aged 40+ years * female	-0.052 (0.035)					
Worked 30 or fewer hours in main DHB job * female		-0.158‡ (0.048)				
Worked 31–40 hours * female		-0.051 (0.035)				
Worked 51–60 hours * female		-0.042 (0.033)				
Worked over 60 hours * female		0.029 (0.043)				
Works 1–25 hours in other jobs * female			-0.006 (0.033)			
Works 26 or more hours in other jobs * female			0.107 (0.111)			
One-child family * female				-0.045 (0.040)		
Family with two or more children * female				-0.083‡ (0.032)		
Overseas trained * female					-0.001 (0.028)	
Recent migrant * female					-0.002 (0.059)	
Honours or master's * female						0.068† (0.032)
Doctorate degrees * female						0.105‡ (0.034)
One-child family				0.035 (0.025)		
Family with two or more children				0.040† (0.019)		
Overseas trained					0.022 (0.016)	
Recent migrant (arrived March 2012 or later)					0.077† (0.038)	
Flexible age controls	No	Yes	Yes	Yes	Yes	Yes
Age category fixed effects	Yes	No	No	No	No	No
Specialty fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
R ²	0.532	0.548	0.546	0.547	0.547	0.547
Observations	3402	3402	3402	3402	3402	3402

Continued



Table 4 Continued

Dependent variable: hourly wages in main DHB job (ln)

	1	2	3	4	5	6
Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. Flexible age controls are an age spline of order 4. Additional controls are fixed effects for number of hours worked in DHB job, fixed effects for number of hours worked in other jobs and fixed effects for highest qualification. All observation counts have been randomly rounded to base 3. Robust SEs are in parentheses.						
*P<0.10.						
†P<0.05.						
‡P<0.01.						

choosing to work in lower paying specialties. They also control for weekly hours worked in the DHB job, weekly hours worked in other jobs and highest qualification. They are thus not driven by female specialists being more likely to work part time, either for the DHB or in total, and part-time employees earning lower hourly wages than full-time employees. In fact, although female specialists are more likely to work part time in their DHB job, part-time specialists, especially men, tend to earn an hourly wage premium over full-time specialists.

Our results suggest that, at most, 36% of the 12.5% wage gap, or 4.5 percentage points, can be explained by differences in experience. Furthermore, the data show that hourly earnings are relatively stable for men and women beyond approximately 45 years of age, which suggests that beyond a certain level of seniority, hourly wages are determined almost entirely by factors other than experience.

In the context of the MECA that governs the earnings of DHB-employed medical specialists, the gender wage gap we estimate could arise from one of two places. First, men with the same experience could be placed in higher steps on the salary scale on recruitment. This has greater potential to occur for specialists who work in New Zealand after gaining experience overseas than for New Zealand-trained specialists who have worked only in New Zealand, who are more likely to enter the pay scale on the lowest rung and deterministically progress up a step each year. Second, men could receive larger payments over and above the MECA minimum, which could include recruitment and retention benefits or special contributions benefits.

Although we do not find direct evidence that male specialists who migrate to New Zealand are initially placed on a higher pay step than similar female specialists, we do find a substantial gender pay gap among new immigrants and are unable to rule out that such unequal treatment occurs. Our data do not allow us to distinguish base salary as specified by the MECA from the various additional payments, but our results are consistent with male specialists disproportionately receiving additional payments beyond the MECA minimum for their salary step. This demonstrates that an employment agreement that specifies minimum wages for each level of experience and progression through these levels is insufficient

to eliminate the gender wage gap between similar men and women with the same experience.

The broader literature on gender pay equality proposes employer discrimination and more successful salary negotiation on the part of men as two potential explanations for a gender wage gap such as that observed here. It is possible that both play a role in the gender wage gap for medical specialists.

Although the gender wage gap we estimate is sizeable, it is smaller than the average gap for high-skilled occupations in New Zealand.¹⁷ Two major factors may contribute to limiting the gender wage gap in our setting. First, the near-universally applicable MECA likely reduces the scope for negotiation that may favour men. Second, the labour market for medical specialists in New Zealand is tight, with DHBs perpetually struggling to fill positions; ASMS research suggests in 2020 the shortage of specialists ranged across DHBs from 17 to 36%.²⁰ Theoretically, this means it is more costly for employers to discriminate against women,²¹⁻²³ and previous research¹⁵ has shown in such situations gender wage gaps do tend to be lower, particular when product markets are competitive.

Our research approach has several limitations, a key one being that we are unable to identify what drives the gender wage gap. Another possible limitation is that the sources of the data on hours worked and monthly earnings are different. Some error is introduced through mismatched individuals and individuals whose pay in March 2013 was the result of a different numbers of hours of work to their usual hours, and some specialists with three or more jobs are lost because the hours worked in their DHB job cannot be identified. The cross-sectional data also mean that the wage growth of individual specialists over time cannot be analysed.

Nevertheless, this research provides clear evidence that there are likely to be significant issues with gender pay inequity for medical specialists working in New Zealand's public health system. The results of this research indicate a need for a comprehensive series of gender pay audits within the nation's DHBs and to ensure that existing and future remuneration arrangements are fair and unbiased.

Acknowledgements Access to the anonymised data used in this study was provided by Statistics New Zealand in accordance with security and confidentiality provisions of the Statistics Act 1975, and secrecy provisions of the

Tax Administration Act 1994. The findings are not Official Statistics. The results in this paper are the work of the authors, not Statistics NZ, Motu Economic and Public Policy Research, or the Association of Salaried Medical Specialists, and have been confidentialised to protect individuals, households, businesses and other organisations from identification. See the Motu Working Paper version of this research (http://motu-www.motu.org.nz/wpapers/19_21.pdf) for the full disclaimer.

Contributors The research was designed and conducted by IS and BB-B, with contributions received from CNLC. All authors edited and revised the final submission and signed off on the final version.

Funding This research was funded by the Association of Salaried Medical Specialists.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Charlotte Nesta Louise Chambers <http://orcid.org/0000-0003-4081-1345>

REFERENCES

- 1 Asgari MM, Carr PL, Bates CK. Closing the gender wage gap and achieving professional equity in medicine. *JAMA* 2019;321:1665–6.
- 2 Warner AS, Lehmann LS. Gender wage disparities in medicine: time to close the gap. *J Gen Intern Med* 2019;34:1334–6.
- 3 Esteves-Sorenson C, Snyder J. The gender earnings gap for physicians and its increase over time. *Econ Lett* 2012;116:37–41.
- 4 Cheng TC, Scott A, Jeon S-H, *et al*. What factors influence the Earnings of general practitioners and medical specialists? Evidence from the medicine in Australia: balancing employment and life survey. *Health Econ* 2012;21:1300–17.
- 5 Rimmer A. The gender pay gap: female doctors still earn a third less than male doctors. *BMJ*;2017;j1967.
- 6 Mainardi GM, Cassenote AJF, Guilloux AGA, *et al*. What explains wage differences between male and female Brazilian physicians? A cross-sectional nationwide study. *BMJ Open* 2019;9:e023811.
- 7 Rimmer A. Why do female doctors earn less money for doing the same job? *BMJ* 2014;349:g5604.
- 8 Jena AB, Olenski AR, Blumenthal DM. Sex differences in physician salary in US public medical schools. *JAMA Intern Med* 2016;176:1294–304.
- 9 Schurer S, Kuehnle D, Scott A. A man's blessing or a woman's curse? The family earnings gap of doctors. *A Journal of Economy and Society* 2016;55:385–414.
- 10 Mikol F, Franc C. Gender differences in the incomes of self-employed French physicians: the role of family structure. *Health Policy* 2019;123:666–74.
- 11 Greenberg CC. Association for academic surgery presidential address: sticky floors and glass ceilings. *J Surg Res* 2017;219:ix–xviii.
- 12 Arora VM. It is time for equal pay for equal work for Physicians-Paging DR Ledbetter. *JAMA Intern Med* 2016;176:1305–6.
- 13 Organisation for economic co-operation and development <https://data.oecd.org/earnwage/gender-wage-gap.htm>
- 14 Statistics New Zealand. Gender pay gap unchanged since 2017, 2017. Available: <https://www.stats.govt.nz/news/gender-pay-gap-unchanged-since-2017>
- 15 Sin I, Stillman S, Fabling R. What drives the gender wage gap? examining the roles of sorting, productivity differences, and discrimination. *Review of Economics and Statistics* forthcoming https://direct.mit.edu/rest/article/doi/10.1162/rest_a_01000/97752/What-Drives-the-Gender-Wage-Gap-Examining-the
- 16 Sin I, Dasgupta K, Pacheco G. Parenthood and labour market outcomes. Available at SSRN 1387106 2018.
- 17 Pacheco G, Li C, Cochrane B. *Empirical evidence of the gender pay gap in New Zealand*. Wellington: Ministry for Women, 2017: 26 p.
- 18 ASMS. New Zealand district health boards senior medical and dental officers collective agreement, 1 July 2013 until 30 June 2016 2013.
- 19 Sin I, Bruce-Brand B. Is the pay of medical specialists in New Zealand gender biased? *Motu Working Paper* 2019:19–21.
- 20 ASMS. research brief 25 2020 https://www.asms.org.nz/wp-content/uploads/2020/02/Southern-Staffing-Survey_172890.1.pdf
- 21 Black DA. Discrimination in an equilibrium search model. *J Labor Econ* 1995;13:309–34.
- 22 Bowlus AJ, Eckstein Z. Discrimination and skill differences in an equilibrium search Model*. *Int Econ Rev* 2002;43:1309–45.
- 23 Flabbi L. Gender discrimination estimation in a search model with matching and BARGAINING*. *Int Econ Rev* 2010;51:745–83.