Does Patient Gender Impact Resident Physicians' Approach to the Cardiac Exam?

Rosette J. Chakkalakal, MD, MHS¹, Stacy M. Higgins, MD², Lisa B. Bernstein, MD², Kristina L. Lundberg, MD², Victor Wu, MD, MPH³, Jacqueline Green, MD, MPH³, Qi Long, PhD⁴, and Joyce P. Doyle, MD²

¹Division of General Internal Medicine and Public Health, Department of Internal Medicine, Vanderbilt University School of Medicine, Nashville, TN, USA; ²Division of General Medicine, Department of Internal Medicine, Emory University School of Medicine, Atlanta, GA, USA; ³Department of Internal Medicine, Emory University School of Medicine, Atlanta, GA, USA; ⁴Department of Biostatistics and Bioinformatics, Rollins School of Public Health, Emory University, Atlanta, GA, USA.

BACKGROUND: Physical examination remains an important part of the initial evaluation of patients presenting with chest pain but little is known about the effect of patient gender on physician performance of the cardiovascular exam.

OBJECTIVE: To determine if resident physicians are less likely to perform five key components of the cardiovascular exam on female versus male standardized patients (SPs) presenting with acute chest pain.

DESIGN: Videotape review of SP encounters during Objective Structured Clinical Examinations (OSCEs) administered by the Emory University Internal Medicine Residency Program in 2006 and 2007. Encounters were reviewed to assess residents' performance of five cardiac exam skills: auscultation of the aortic, pulmonary, tricuspid, and mitral valve areas and palpation for the apical impulse.

PARTICIPANTS: One hundred forty-nine incoming residents.

MAIN MEASURES: Residents' performance for each skill was classified as correct, incorrect, or unknown.

KEY RESULTS: One hundred ten of 149 (74 %) of encounters were available for review. Residents were less likely to correctly perform each of the five skills on female versus male SPs. This difference was statistically significant for auscultation of the tricuspid ($p=0.004$, RR=0.62, 95 % CI 0.46–0.83) and mitral ($p=0.007$, RR=0.58, 95 % CI=0.41–0.83) valve regions and palpation for the apical impulse ($p<0.001$, RR=0.27, 95 % CI=0.16–0.47). Male residents were less likely than female residents to correctly perform each maneuver on female versus male SPs. The interaction of SP gender and resident gender was statistically significant for auscultation of the mitral valve region ($p=0.006$) and palpation for the apical impulse ($p=0.01$).

CONCLUSIONS: We observed significant differences in the performance of key elements of the cardiac exam for female versus male SPs presenting with chest pain. This observation represents a previously unidentified but potentially important source of gender bias in the evaluation of patients presenting with cardiovascular complaints.

KEY WORDS: cardiovascular disease; clinical skills assessment; disparities; women's health; medical student and residency education.

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INTRODUCTION

Heart disease is the leading cause of death in men and women but significant gender differences exist in physicians' evaluation of patients presenting with chest pain.¹ Among patients presenting to the emergency department with new-onset chest pain, men are more likely than women to receive emergency cardiology consults, noninvasive cardiac tests and invasive cardiac procedures.^{2,3} Physical examination is an important part of the initial evaluation of patients with suspected cardiac disease, but little is known about the effect of patient gender on physician performance of the cardiovascular exam in patients presenting with chest pain.⁴

Prior studies have identified differences in performance of the physical exam according to patient gender but the nature of the gender bias has varied by examination site. For example, students have been found to score better on abdominal exams of male standardized patients (SPs) compared to female SPs⁵ but worse on lymphatic system exams of male SPs compared to female SPs.⁶ Carson et al. recently found that female students rated significantly higher than male students at cardiac and respiratory exam stations with a female SP⁷ but the study focused on the effect of provider gender more than patient gender. Regardless of

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the site, physicians develop the skills they need to examine patients as medical students; proficiency in cardiac examination appears to be especially influenced by medical school training.^{4,8} Therefore deficiencies in physical examination, including gender bias, may be amenable to improvement through focused interventions in early medical education.

The purpose of this study was to determine if resident physicians are less likely to perform five key components of the cardiac physical exam in female versus male patients presenting with acute chest pain. Additionally, we sought to determine if resident gender modifies the effect of patient gender on the performance of these five elements of the cardiovascular exam. By focusing on individual maneuvers within the cardiac exam, we sought to highlight the specific skills that are prone to gender bias so that educators can develop targeted interventions for these skills.

METHODS

Description of Participants

In 2006 and 2007, all first-year residents in the Emory University Internal Medicine Residency Program participated in Objective Structured Clinical Examinations (OSCEs) during intern orientation. Each resident evaluated a middle-aged male or female SP with acute substernal chest pain. Residents had 20 minutes to complete a focused history and physical examination and formulate an assessment and plan. Faculty members observed the encounters remotely via live-streaming video, then provided direct feedback to the residents in the exam room at the end of the encounter. The videos of each SP encounter were also recorded for later review.

Data Abstraction

We conducted a cross-sectional study using video recordings of the orientation OSCEs from 2006 to 2007. An unblinded reviewer watched each videotape to determine if residents correctly performed five cardiac exam elements: auscultation of the aortic, pulmonic, tricuspid, and mitral valve areas and palpation of the apical impulse. The performance of each element was determined to be correct, incorrect, or unknown. If the maneuver was done at the correct location and directly against the patient's skin, the performance of that component was considered correct. If the maneuver was not done or done at the incorrect location or over the patient's clothing (incorrect technique), the performance of that component was considered incorrect. If the

maneuver could not be visualized due to gown draping and/or poor camera angle, the performance of that component was considered unknown.

To test the reliability of these observations, a blinded second reviewer independently evaluated resident performance for each of the five maneuvers. In cases in which the results of the first and second reviews differed, a blinded third reviewer adjudicated the discordant evaluations. The final scores for analysis, therefore, included all concordant scores (where the first and second reviewers agreed in their assessments of resident performance) and the adjudicated scores of the third reviewer (where the first and second reviewers disagreed in their assessments of resident performance). For a comparison of scores from the first and second reviewers by cardiac exam maneuver, see Appendix 1. The study was approved by the Emory University Institutional Review Board through expedited review.

Statistical Analysis

The primary study outcome was performance of each of the five components of the cardiac exam on female versus male SPs. We used χ^2 test to compare the number of correct to incorrect performances by SP gender for each component, excluding unknown observations. The strength of the association between SP gender and performance was estimated by calculating the relative risk of correct performance of exam components on female SPs compared to male SPs.

To determine if resident gender was an effect modifier, we stratified our results by resident gender and calculated stratum-specific relative risks of correct performance on female SPs compared to male SPs for each component. Relative risk regression was used to test the significance of the interaction of SP gender and resident gender on the performance of each component of the cardiac exam.

RESULTS

There were 149 incoming residents participating in the OSCEs (84 residents in 2006 and 65 residents in 2007). Due to technical difficulties, 35 SP encounters were not recorded. Additionally, four videos were lost between the time of the first review and the second and third reviews. The residents evaluated in the remaining 110 encounters came from 55 different medical schools; 60 residents were male and 50 residents were female. In 2006, 23 residents examined a female SP and 26 residents examined a male SP; in 2007 all SPs were female. We evaluated resident performance for 84 female SP encounters and 26 male SP encounters.

Figure 1 Percent distribution of correct, incorrect, and unknown evaluations of cardiac exam maneuvers performed by female residents on male and female standardized patients. Legend: Unknown (purple), Incorrect (Not performed) (green), Incorrect (Incorrect technique) (red), Correct (blue).

Figures 1 and 2 show the percent distribution of correct, incorrect and unknown evaluations performed by female and male residents for each of the five cardiac exam components on male versus female SPs. Figures 1 and 2 also show the breakdown of the incorrect performances by those performances that were incorrect due to technique versus those that were not done at all. Of residents who incorrectly palpated the apical impulse in female SPs, over 74 % did not perform the skill at all which in the end represented 55 % of all evaluations of the apical impulse in female SPs.

Figure 2 Percent distribution of correct, incorrect, and unknown evaluations of cardiac exam maneuvers performed by male residents on male and female standardized patients. Legend: Unknown (purple), Incorrect (Not performed) (green), Incorrect (Incorrect technique) (red), Correct (blue).

Table 1. Comparison of Correct and Incorrect Evaluations for each Cardiac Exam Component, All Residents

	Correct n (%)	Incorrect n (%)	P- value*	Relative Risk RR (95 % CI)
Aortic				
Female SP	55 (66)	8 (10)	0.65	0.96 (0.82–1.13)
Male SP	20 (77)	2 (8)		Referent
Pulmonic				
Female SP	57 (68)	6 (7)	0.95	1.00 (0.85–1.16)
Male SP	20 (77)	2 (8)		Referent
Tricuspid				
Female SP	28 (33)	24 (29)	0.004	0.62 (0.46–0.83)
Male SP	21 (81)	3 (12)		Referent
Mitral				
Female SP	27 (32)	34 (41)	0.007	0.58 (0.41–0.83)
Male SP	19 (73)	6 (23)		Referent
Apical Impulse				
Female SP	14 (17)	62 (74)	<0.001	0.27 (0.16–0.47)
Male SP	17 (65)	8 (31)		Referent

For each maneuver, a total of 84 female SPs and 26 male SPs were examined. Percentages do not sum to 100 because unknown evaluations have been excluded as missing data. **p*-value for Chi square test.

Residents were less likely to perform all five components of the cardiac physical exam on female SPs than male SPs (Table 1). This difference was statistically significant for auscultation of the tricuspid and mitral valve regions and palpation of the apical impulse ($p=0.004$, $p=0.007$, and $p<0.001$, respectively). Based on the relative risk estimates, residents were 39 % less likely to correctly auscultate the tricuspid valve region, 42 % less likely to correctly auscultate the mitral valve region, and 73 % less likely to correctly palpate the apical impulse on female versus male SPs.

Male residents were less likely than female residents to correctly perform all maneuvers for female SPs compared to male SPs (Table 2). The interaction of SP gender and resident gender was statistically significant for auscultation of the mitral valve region and palpation of the apical impulse ($p=0.006$ and $p=0.01$, respectively), meaning that the difference in the relative risk of correctly performing these two cardiac exam components by male versus female residents was statistically significant. Using the stratum-specific relative risk estimates, we see that female residents were 10 % more likely to correctly auscultate the mitral valve region on female versus male SPs whereas male residents were 64 % less likely to correctly auscultate the mitral valve region on female versus male SPs. Female residents were 44 % less likely to correctly palpate the apical impulse on female versus male SPs whereas male residents were 88 % less likely to correctly palpate the apical impulse in female versus male SPs.

Table 2. Comparison of Correct and Incorrect Evaluations for each Cardiac Exam Component Stratified by Resident Gender

	Correct <i>n</i> (%)	Incorrect <i>n</i> (%)	<i>P</i> - value*	Relative Risk RR (95 % CI)
Female Resident [†]				
Aortic				
Female SP	26 (67)	4 (10)	0.78	0.96 (0.75–1.24) Referent
Male SP	9 (82)	1 (9)		
Pulmonic				
Female SP	27 (69)	3 (8)	1.00	1 (0.79–1.27) Referent
Male SP	9 (82)	1 (9)		
Tricuspid				
Female SP	17 (44)	9 (23)	0.39	0.82 (0.54–1.24) Referent
Male SP	8 (73)	2 (18)		
Mitral				
Female SP	15 (39)	10 (26)	0.76	1.10 (0.59–2.06) Referent
Male SP	6 (55)	5 (46)		
Apical Impulse				
Female SP	10 (26)	23 (59)	0.15	0.56 (0.26–1.17) Referent
Male SP	6 (55)	5 (46)		
Male Resident ^{††}				
Aortic				
Female SP	29 (64)	4 (9)	0.72	0.96 (0.78–1.19) Referent
Male SP	11 (73)	1 (7)		
Pulmonic				
Female SP	30 (67)	3 (7)	0.94	0.99 (0.81–1.21) Referent
Male SP	11 (73)	1 (7)		
Tricuspid				
Female SP	11 (24)	15 (33)	0.002	0.46 (0.28–0.73) Referent
Male SP	13 (87)	1 (7)		
Mitral				
Female SP	12 (27)	24 (53)	<0.001	0.36 (0.22–0.58) Referent
Male SP	13 (87)	1 (7)		
Apical Impulse				
Female SP	4 (9)	39 (87)	<0.001	0.12 (0.05–0.31) Referent
Male SP	11 (73)	3 (2)		

[†]For maneuvers performed by female residents, 39 female SPs were examined and 11 male SPs were examined. ^{††}For maneuvers performed by male residents, 45 female SPs were examined and 15 male SPs were examined. Percentages do not sum to 100 because unknown evaluations have been excluded as missing data. *p-value for Chi square test.

DISCUSSION

Our study demonstrates that residents are less likely to correctly perform key elements of the cardiac physical exam on female SPs presenting with acute chest pain than on male SPs with similar complaints. Since our study evaluated the performance of individual cardiac examination skills, we were able to specifically identify the greatest gender differences for maneuvers closest to the breast, including auscultation of the tricuspid and mitral valve regions and palpation for the apical impulse. We also found that male residents were less likely than their female colleagues to correctly auscultate the mitral valve region

and palpate for the apical impulse on female versus male patients.

Although previous studies have identified gender differences in physical examination, few studies have sought to identify these differences in performance of the cardiac exam in particular. Carson et al. recently examined the effect of patient and/or provider gender on gender-sensitive OSCE stations (defined as “a station that might evoke discomfort or embarrassment due to gender differences of the patient, student, or a combination of both”) by studying medical student performance at the cardiac and respiratory stations since these examinations include skills performed on the anterior aspect of chest.⁷ Female students were rated significantly higher than male students at both the cardiac and respiratory exam stations overall and particularly at the stations with a female SP.⁷ Our findings support Carson’s conclusion that the interaction of provider gender and patient gender has an important effect on performance of gender-sensitive examinations including the cardiac exam. Since our study evaluated the performance of individual cardiac examination skills rather than overall performance at a cardiac OSCE station, we are also able to more specifically identify “gender-sensitive” maneuvers within the cardiac exam as being those that are closest to the breast, including auscultation of the mitral valve region and palpation of the apical impulse. Additionally, our study highlights the main effect of patient gender (rather than provider gender) on performance of the cardiac exam.

The significantly greater gender bias that we observed for cardiac exam maneuvers closest to the breast may be due to several factors. Concern for patient modesty during gender-sensitive examinations may deter physicians from performing thorough cardiac examinations without a chaperone in the room. Physicians who practice cardiac examination skills on male colleagues or cardiac patient simulators that represent male anatomy may also lack knowledge of appropriate techniques to examine the heart in the area around the female breast. Indeed, previous studies have hypothesized that an under-representation of women in illustrations of non-reproductive anatomy in physical diagnosis texts may promote gender bias in the teaching of physical examination early in medical education.⁹ Since our study detects gender bias in trainees prior to the start of residency, we recommend implementing interventions to address this bias during undergraduate medical training. Greater emphasis on gender-specific examination maneuvers such as lifting the left breast to facilitate auscultation of the mitral valve region and palpation of the apical impulse in a

manner that is comfortable to both physician and patient may address some of the greatest gender differences observed in our study. Focused feedback for medical students and residents on their performance of the cardiac exam during routine clinical encounters could also reduce gender bias when it is observed at the bedside.

Our study has a number of limitations. For example, the gender bias we observed may have been due to factors we could not adjust for since the videos that were available for review did not include information about the SP or resident that may have influenced resident performance of the cardiac exam such as the BMI, age, and ethnicity of the SP or if residents had received specialized training in cardiology or physical examination prior to the OSCE. We adjusted for resident gender because this information was readily available and because previous studies suggested the importance of this particular covariate in assessments of gender bias in physical examination; still, we recognize the need for future studies specifically designed to evaluate gender differences in performance of the cardiac exam in the context of all relevant covariates. Additionally, since the training curriculum includes only OSCE evaluations, we cannot know if practice patterns would vary with real patients.

Variation in the performance of key cardiac examination skills in female versus male patients is a previously unidentified but potentially important source of gender bias in the evaluation of patients with suspected heart disease. For example, the presence of a third heart sound (S_3) in patients with acute chest pain has been found to increase the probability of myocardial infarction more than a history of angina or coronary artery disease or a reported duration of chest pain of greater than 60 minutes.¹⁰ According to our findings, residents are significantly less likely to correctly auscultate the mitral valve region (where an S_3 is usually detected) in women versus men and therefore may be more likely to miss this important finding in women than in men.¹¹ The preliminary observations we present here highlight important gender differences in cardiac examination that should be further investigated with a dedicated evaluation of this topic. Since physicians develop essential physical examination skills during medical school that they carry with them throughout residency, we recommend raising awareness of the potential for gender bias in the cardiac physical examination at the level of undergraduate medical education with reinforcement during residency and beyond. We hope the findings from this initial analysis will prompt research and innovation to better understand and address this unique source of gender bias in the evaluation of patients with chest pain.

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The preliminary results of this project were presented as a poster presentation at the ACGME/ABMS 2007 Joint Conference "Physician Competence: From Deconstruction to Reconstruction" in September 2007 and as an oral presentation at the Southern Society of General Internal Medicine Annual Meeting where Dr. Chakkalakal was awarded the Best Resident Abstract Award in March 2008 as well as at the Society of General Internal Medicine 31st Annual Meeting in April 2008 where Dr. Chakkalakal was a Lipkin Award Finalist.

Conflict of Interest: The authors declare that they do not have a conflict of interest.

Corresponding Author: Rosette J. Chakkalakal, MD, MHS; Division of General Internal Medicine and Public Health, Department of Internal Medicine, Vanderbilt University School of Medicine, 1215 21st Ave South, 6000 Medical Center East, NT, Nashville, TN 37232-8300, USA (e-mail: rosette.j.chakkalakal@vanderbilt.edu).

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APPENDIX 1. COMPARISON OF SCORES FROM REVIEWER 1 AND 2 BY CARDIAC EXAM MANEUVER

Table 3. Aortic Auscultation

		Reviewer 2		
Reviewer 1		Correct	Incorrect	Unknown
	Correct	61	0	3
	Incorrect	3	9	0
	Unknown	27	1	8

Table 4. Pulmonic Auscultation

		Reviewer 2		
Reviewer 1		Correct	Incorrect	Unknown
	Correct	62	0	3
	Incorrect	3	8	0
	Unknown	27	0	9

Table 6. Mitral Auscultation

		Reviewer 2		
Reviewer 1		Correct	Incorrect	Unknown
	Correct	33	0	1
	Incorrect	15	29	6
	Unknown	9	2	17

Table 5. Tricuspid Auscultation

		Reviewer 2		
Reviewer 1		Correct	Incorrect	Unknown
	Correct	35	0	2
	Incorrect	12	22	2
	Unknown	15	2	22

Table 7. Palpation of Apical Impulse

		Reviewer 2		
Reviewer 1		Correct	Incorrect	Unknown
	Correct	21	2	3
	Incorrect	9	66	0
	Unknown	3	2	5