Association of trainee participation with adenoma and polyp detection rates.

Emad Qayed, Emory University
Lauren Shea, Emory University
Stephan Goebel, Emory University
Roberd M Bostick, Emory University

Journal Title: World Journal of Gastrointestinal Endoscopy
Volume: Volume 9, Number 5
Publisher: Baishideng Publishing Group | 2017-05-16, Pages 204-210
Type of Work: Article | Final Publisher PDF
Publisher DOI: 10.4253/wjge.v9.i5.204
Permanent URL: https://pid.emory.edu/ark:/25593/tnhhr

Final published version: http://dx.doi.org/10.4253/wjge.v9.i5.204

Copyright information:
©The Author(s) 2017. Published by Baishideng Publishing Group Inc. All rights reserved.
This is an Open Access work distributed under the terms of the Creative Commons Attribution-NoDerivatives 4.0 International License (http://creativecommons.org/licenses/by-nd/4.0/).

Accessed January 22, 2020 7:02 AM EST
### ORIGINAL ARTICLE

#### Retrospective Study

204  
**Association of trainee participation with adenoma and polyp detection rates**  
*Qayed E, Shea L, Goebel S, Bostick RM*

---

211  
**Nerve preserving vs standard laparoscopic sacropexy: Postoperative bowel function**  
*Cosma S, Petruzzelli P, Danese S, Benedetto C*

### Observational Study

220  
**Adult intussusception: A case series and review**  
*Shenoy S*

### META-ANALYSIS

228  
**Does music reduce anxiety and discomfort during flexible sigmoidoscopy? A systematic review and meta-analysis**  
*Shanmuganandam AP, Siddiqui MRS, Farkas N, Sran K, Thomas R, Mohamed S, Swift RI, Abulafi AM*

### CASE REPORT

238  
**Successful endoscopic treatment of an intraductal papillary neoplasm of the bile duct**  
*Natov NS, Horton LC, Hegde SR*
World Journal of Gastrointestinal Endoscopy
Volume 9 Number 5 May 16, 2017

ABOUT COVER
Editorial Board Member of World Journal of Gastrointestinal Endoscopy, A Marcelo Campos Silva, MSc, Academic Research, Medical Assistant, Department of Gastroenterology and Endoscopy, Hospital Mae de Deus, Porto Alegre, RS 90430-091, Brazil

AIM AND SCOPE
World Journal of Gastrointestinal Endoscopy (World J Gastroint Endosc, WJGE, online ISSN 1948-5190, DOI: 10.4253) is a peer-reviewed open access (OA) academic journal that aims to guide clinical practice and improve diagnostic and therapeutic skills of clinicians.

WJGE covers topics concerning gastroscopy, intestinal endoscopy, colonoscopy, capsule endoscopy, laparoscopy, interventional diagnosis and therapy, as well as advances in technology. Emphasis is placed on the clinical practice of treating gastrointestinal diseases with or under endoscopy.

We encourage authors to submit their manuscripts to WJGE. We will give priority to manuscripts that are supported by major national and international foundations and those that are of great clinical significance.

INDEXING/ABSTRACTING
World Journal of Gastrointestinal Endoscopy is now indexed in Emerging Sources Citation Index (Web of Science), PubMed, and PubMed Central.

FLYLEAF
I-III Editorial Board

EDITORS FOR THIS ISSUE
Responsible Assistant Editor: Xiang Li
Responsible Science Editor: Jin-Xin Kong
Responsible Electronic Editor: Huan-Liang Wu
Proofing Editorial Office Director: Xiu-Xia Song

NAME OF JOURNAL
World Journal of Gastrointestinal Endoscopy
ISSN
ISSN 1948-5190 (online)
LAUNCH DATE
October 15, 2009
FREQUENCY
Monthly
EDITORS-IN-CHIEF
Atsushi Imagawa, PhD, Director, Department of Gastroenterology, Mitoyo General Hospital, Kani-cho, Kagawa 769-1695, Japan
Juan Manuel Herrerias Gutierrez, PhD, Academic Fellow, Chief Doctor, Professor, Unidad de Gestión Clínica de Aparato Digestivo, Hospital Universitario Virgen Macarena, Sevilla 41009, Sevilla, Spain

EDITORIAL BOARD MEMBERS
All editorial board members resources online at http://www.wjgnet.com/1948-5190/editorialboard.htm

EDITORIAL OFFICE
Xiu-Xia Song, Director
World Journal of Gastrointestinal Endoscopy
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: editorialoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLISHER
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLICATION DATE
May 16, 2017

COPYRIGHT
© 2017 Baishideng Publishing Group Inc. Articles published by this Open-Access journal are distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non-commercial and is otherwise in compliance with the license.

SPECIAL STATEMENT
All articles published in journals owned by the Baishideng Publishing Group (BPG) represent the views and opinions of their authors, and not the views, opinions or policies of the BPG, except where otherwise explicitly indicated.

INSTRUCTIONS TO AUTHORS
http://www.wjgnet.com/bpg/geninfo/204

ONLINE SUBMISSION
http://www.f6publishing.com

WJGE | www.wjgnet.com
Association of trainee participation with adenoma and polyp detection rates

Emad Qayed, Lauren Shea, Stephan Goebel, Roberd M Bostick

Emad Qayed, Lauren Shea, Stephan Goebel, Department of Medicine, Division of Digestive diseases, Emory University School of Medicine, Atlanta, GA 30324, United States

Emad Qayed, Grady Memorial Hospital, Atlanta, GA 30303, United States

Roberd M Bostick, Emory University Rollins School of Public Health, Department of Epidemiology, Atlanta, GA 30324, United States

Roberd M Bostick, Emory University, Winship Cancer Institute Atlanta, GA 30324, United States

Author contributions: Qayed E designed the research, collected and analyzed the data, drafted, and revised the manuscript; Shea L collected the data and revised the manuscript; Goebel S collected the data and revised the manuscript; Bostick RM designed the research and revised the manuscript for important intellectual content; all authors read and approved the final version of the manuscript.

Institutional review board statement: The study was reviewed and approved by Emory University Institutional Review Board.

Informed consent statement: Informed consent was waived by the Institutional Review Board due to the retrospective nature of the study, the large number of patients, the rights and welfare of the subjects will not be adversely affected by this research.

Conflict-of-interest statement: The authors report no conflict of interest.

Data sharing statement: Statistical code is available from the corresponding author at eqayed@emory.edu. Consent was not obtained, but the presented data are anonymized with no risk of identification. No additional data are available.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is 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 and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/

Manuscript source: Invited manuscript

Correspondence to: Dr. Emad Qayed, MD, MPH, Chief of Gastroenterology, Grady Memorial Hospital, 49 Jesse Hill Junior Drive, Atlanta, GA 30303, United States. eqayed@emory.edu
Telephone: +1-404-7781685
Fax: +1-404-7781681

Received: December 7, 2016
Peer-review started: December 8, 2016
First decision: January 7, 2017
Revised: January 12, 2017
Accepted: February 28, 2017
Article in press: March 2, 2017
Published online: May 16, 2017

Abstract

AIM
To investigate whether adenoma and polyp detection rates (ADR and PDR, respectively) in screening colonoscopies performed in the presence of fellows differ from those performed by attending physicians alone.

METHODS
We performed a retrospective review of all patients who underwent a screening colonoscopy at Grady Memorial Hospital between July 1, 2009 and June 30, 2015. Patients with a history of colon polyps or cancer and those with poor colon preparation or failed cecal intubation were excluded from the analysis. Associations of fellowship training level with the ADR and PDR relative to attendings alone were assessed using unconditional multivariable logistic regression. Models were adjusted for sex, age, race, and colon preparation...
quality.

RESULTS

A total of 7503 colonoscopies met the inclusion criteria and were included in the analysis. The mean age of the study patients was 58.2 years; 63.1% were women and 88.2% were African American. The ADR was higher in the fellow participation group overall compared to that in the attending group: 34.5% vs 30.7% (P = 0.001), and for third year fellows it was 35.4% vs 30.7% (aOR = 1.23, 95%CI: 1.09-1.39). The higher ADR in the fellow participation group was evident for both the right and left side of the colon. For the PDR the corresponding figures were 44.5% vs 40.1% (P = 0.0003) and 45.7% vs 40.1% (aOR = 1.25, 95%CI: 1.12-1.41). The ADR and PDR increased with increasing fellow training level (P for trend < 0.05).

CONCLUSION

There is a stepwise increase in ADR and PDR across the years of gastroenterology training. Fellow participation is associated with higher adenoma and polyp detection.

Key words: Screening colonoscopy; Adenoma detection rate; Polyp detection rate; Gastroenterology training; Colorectal cancer

© The Author(s) 2017. Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: In this large sample of screening colonoscopies, we found that fellow participation has an overall favorable effect on adenoma and polyp detection rates, especially for fellows after their first year of training. The higher detection rate was evident in both the right and left colon. There were no differences overall regarding adenoma per colon or polyp per colon, between the fellow participation and attending groups. In summary, performance of screening colonoscopies by fellows under the strict supervision of attendings does not negatively affect the quality of the procedure, but rather increases adenoma and polyp detection.

INTRODUCTION

Colorectal cancer (CRC) is the third most common cancer and second leading cause of cancer death in the United States. In 2016, it is estimated that 134490 individuals will be diagnosed with CRC, and approximately 49190 will die from this disease (26020 males and 23170 females)\textsuperscript{[1]}. While these numbers are substantial, there has been an overall steady decline in the incidence of CRC, which represents a 40% decrease since 1975. More recently, between 2008 and 2012, CRC incidence decreased annually by about 3.6% in men and 3.8% in women\textsuperscript{[1,2]}. An increase in screening for CRC with colonoscopy and other modalities is the most likely cause of those declines in CRC incidence. Colonoscopy is an important screening modality for CRC. The advantages of colonoscopy compared to the other modalities are the ability to directly examine the colonic mucosa and remove precancerous polyps during one session. The American College of Gastroenterology recommends colonoscopy as the preferred screening modality\textsuperscript{[3]}. The results from several studies support that colonoscopy and polypectomy decrease mortality from colon cancer\textsuperscript{[4,5]}. However, it has been consistently shown that the quality of colonoscopy varies among providers, and is dependent on several factors such as colon preparation quality, skills of the endoscopist, and length of withdrawal (examination) time. Furthermore, some studies found that colonoscopy decreases the risk of distal, but not proximal, colon cancer\textsuperscript{[6,7]}. Given the importance of providing a quality colonoscopy, there is great interest in studying the effects of different procedural factors on the Adenoma and Polyp Detection Rates (ADR and PDR). Central to this discussion is the skill of the provider performing the colonoscopy. Colonoscopy quality differs widely among providers, and studies have reported a wide range of ADR (15%-50%) among endoscopists\textsuperscript{[8,9]}. There is also some evidence that colonoscopies performed by gastroenterologists are associated with higher protection against colon cancer than are those performed by other providers\textsuperscript{[9]}. Fellow participation in screening colonoscopy affects the quality of the procedure, and whether their skill level changes substantially enough within the first year of training to affect their screening colonoscopy ADR and PDR. Most fellows in their third year of training have acquired adequate endoscopic skills, are ready for unsupervised practice, and are considered more skillful than first and second year fellows. Given that there is a known learning curve for colonoscopy, it is unclear whether the participation of fellows in screening colonoscopy affects the quality of the procedure, and whether their skill level at different stages of their training contributes to any changes in the quality of colonoscopy. There are relatively few reported studies that addressed this subject. In a small retrospective study of 309 patients, colonoscopies performed by fellows under the supervision of an attending had a higher ADR compared to those performed by attendings alone (37.2% vs 23%, P < 0.01)\textsuperscript{[10]}. Another retrospective study found that ADRs increased as fellows advanced throughout their fellowship, with third year
fellows having a higher ADR than did attendings (39.5% vs 27.7%), OR = 1.7 (1.33-2.17). Another study found that colonoscopies performed by fellows under the supervision of attendings were associated with a higher detection of small adenomas (< 5 mm), compared to procedures performed without a fellow (25% vs 17%, \( P = 0.001 \)).

There are several limitations to these studies, including the small sample sizes, the small number of procedures performed by fellows, inclusion of non-screening colonoscopies, and no stratification of fellows by year of training.

Herein we provide further clarification on the effect of fellow participation at different stages of training on the quality of screening colonoscopies. The primary aim of our study was to investigate whether GI fellows at various stages of training performing screening colonoscopies have different ADR and PDR compared to attendings. This was done by examining a large database of screening colonoscopies performed in patients aged 40 or older at a large teaching hospital.

**MATERIALS AND METHODS**

This was a retrospective study using the endoscopic procedure database at Grady Memorial Hospital in Atlanta, GA. This database includes prospectively collected information about all endoscopic procedures performed in the Grady Memorial Hospital gastroenterology endoscopy unit, and includes procedure type, patient’s medical record number, age, race, procedure indication, endoscopist, fellow participation in the procedure, and fellow training level. The study included all outpatients who were at least 40 years old who underwent a screening colonoscopy between July 1, 2009 and June 30, 2015. Excluded patients included those who underwent colonoscopy for diagnostic purposes (e.g., abdominal pain, diarrhea, bleeding), surveillance for colorectal polyps, personal history of CRC, colorectal surgery, or inflammatory bowel disease. We also excluded patients whose procedures were aborted due to complications, severe pain and discomfort, failed cecal intubation, and those with poor bowel cleansing preparation ("prep"). The study was approved by the Institutional Review Board.

The computerized medical record was used to confirm the age and race of the patient, endoscopic findings, prep quality, cecal intubation, and polyp size, number, location, and histology. Race was categorized as white, black, and other. Bowel prep quality was categorized as good, fair-adequate, fair-inadequate, and poor. Colonoscopies with fair-adequate prep were those in which the prep quality was judged to allow for detection of all polyps ≥ 5 mm in size. Colonoscopies with poor prep had solid stool and generally required a repeat procedure within 3 mo. Polyp location was divided into right sided (cecum, ascending colon, hepatic flexure, and transverse colon), and left sided (descending colon, sigmoid, and rectum). Polyps were categorized into adenomatous and non-adenomatous polyps. Adenomatous polyps were categorized into advanced and non-advanced adenomas. Advanced adenomas included polyps with size ≥ 10 mm, villous or tubulovillous histology, high-grade dysplasia, or adenocarcinoma. Colonoscopies were categorized according to fellow participation as follows: Attending alone (procedure performed solely by attending) vs fellow present (fellow participated in any part of the procedure). Given that fellows start their fellowship training without endoscopic experience and rapidly accumulate endoscopic skills during their first year of training, fellow participation was also categorized as follows: Attending alone, fellow in first six months of training, fellow in second six months of training, fellow in second year, and fellow in third year.

**Colonoscopy information**

Patients who were candidates for CRC screening were referred to the endoscopy unit from their primary care or gastroenterology clinic. Patients were given a standard 4 L of polyethylene glycol solution as a standard bowel preparation regimen. During the study period, there were 10 attendings and 34 fellows who performed the colonoscopies. In the endoscopy unit, patients were randomly assigned to endoscopy rooms during the course of the day. Attendings staffed the endoscopy rooms, with or without a fellow. All procedures were performed under moderate sedation. In colonoscopies performed with fellows, the fellow started the procedure and attempted insertion of the colonoscope to the cecum. In general, attendings intervened when there was difficulty passing a specific part of the colon, or if there was significant patient discomfort. Once the attending traversed the problematic area of the colon or the patient was better sedated, the scope was usually given back to the fellow to complete the insertion to the cecum and subsequent withdrawal of the scope. However, this was left to the discretion of the attending. Second and third year fellows are usually able to complete the colonoscopy without participation of the attending. The attending physicians strictly monitored all fellows during insertion and withdrawal of the scope.

**Statistical analysis**

Descriptive statistics, including mean, standard deviation, and frequencies, were used to characterize the study population. Characteristics of patients undergoing screening colonoscopy according to whether their colonoscopy was performed by an attending physician alone or with a fellow were compared using the student t test for continuous variables and the chi square test for categorical variables. Differences in the ADR, PDR, and advanced ADR across those for attendings alone and fellows at different points in training duration were assessed using the Mantel-Haenszel \( \chi^2 \) test to calculate the \( P \) for trend (non zero correlation). Associations of fellowship training level with the ADR, PDR, and advanced ADR (AADR) relative to attendings alone were assessed using unconditional multivariable logistic
regression to calculate the adjusted odds ratios (ORs) and 95% CIs. Models were adjusted for sex, age, race, and colon preparation quality. Statistical significance was defined as a two-sided \( P \) value of \( \leq 0.05 \% \) or a 95% CI that excluded 1.0. Analysis was performed using SAS version 9.4.

**RESULTS**

**Patient population**

Between July 1, 2009 and July 1, 2015, 8175 colonoscopies were performed for the sole indication of screening for colon cancer. All procedures were performed under moderate sedation. Of these, 672 colonoscopies were excluded for the following reasons: 565 for poor colon preparation quality, 106 for failed cecal intubation, and 1 complication (laryngospasm). A total of 7503 screening colonoscopies were included in the analysis. Figure 1 shows the study flow diagram leading to the study population. Selected characteristics of the study patients according to whether their colonoscopy was performed by an attending physician alone or with a fellow are summarized in Table 1. The mean age of the study patients was 58.2 years, and 63.1% were women, 88.2% were African American, and 88.9% had a good colon preparation quality. A total of 67.2% of colonoscopies were performed with a training fellow, and an attending alone performed the rest.

**Adenoma, advanced adenoma, and polyp detection rates**

Differences in the ADR, PDR, and advanced ADR across those for attendings alone and fellows at different points in training duration are summarized in Tables 1 and 2. The ADR in the fellow participation group (all levels of training combined) was higher than that in the attending group (34.5% vs 30.7%, \( P = 0.001 \)). The higher ADR in the fellow group was mainly related to second and third year fellows, but not first year fellows. Fellows in their third year of training had a higher ADR than did attendings alone (35.4% vs 30.7%; \( \text{AOR} = 1.23, 95\% \text{CI}: 1.09-1.39 \)). The higher ADR was evident in both the right and left colon. Similarly, the PDR was higher in procedures performed with fellows compared to those performed by attendings alone (44.5% vs 40.1%, \( P = 0.0003 \)). Fellows in their third year of training had a higher PDR than did attendings alone (45.7% vs 40.1%, \( \text{aOR} = 1.25, 95\% \text{CI}: 1.12-1.41 \)). The ADR and PDR statistically significantly increased with increasing fellow training level (trend \( P \) value < 0.05). Fellows also detected more adenomas and polyps than did attendings. The mean number of adenoma per colon (APC) was higher in the fellows’ group than in the attendings alone group (0.68 vs 0.61, \( P = 0.03 \)). Similarly, the mean number of polyps per colon (PPC) was higher in the fellows’ group than in the attendings alone group (0.96 vs 0.86, \( P = 0.01 \)).

There was no difference in the AADR between the fellows group and the attending group (8.3% vs 8.7%, \( P = 0.49 \)). However, fellows in their first six months of training had a lower AADR than did attendings alone (4.8% vs 8.7%, \( \text{aOR} = 0.52, 95\% \text{CI}: 0.35-0.76 \)). We further analyzed this finding by examining the proportion of procedures that had a large adenoma (\( \geq 1 \) cm), villous histology, or high-grade dysplasia (HGD) and/or cancer (Table 3). The lower AADR in the fellows
Table 2  Associations of gastroenterology fellow training level with adenoma detection rate, polyp detection rate, and advanced adenoma detection rate; Grady Memorial Hospital, Atlanta, Georgia, July 1, 2009 – July 1, 2015

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Fellowship training level</th>
<th>Detection rate</th>
<th>Trend P value1</th>
<th>aOR 2</th>
<th>95%CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1 adenoma (ADR)</td>
<td>Attending alone (reference)</td>
<td>30.7%</td>
<td>0.0003</td>
<td>1.00</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 1st 6 mo</td>
<td>32.4%</td>
<td>1.07</td>
<td>0.89-1.3</td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd 6 mo</td>
<td>33.3%</td>
<td>0.96-1.39</td>
<td>0.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd year</td>
<td>34.4%</td>
<td>1.00-1.32</td>
<td>0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 3rd year</td>
<td>35.4%</td>
<td>1.23</td>
<td>1.09-1.39</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>≥ 1 polyp (PDR)</td>
<td>Attending alone (reference)</td>
<td>40.1%</td>
<td>&lt; 0.0001</td>
<td>1.00</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 1st 6 mo</td>
<td>42.4%</td>
<td>1.10</td>
<td>0.92-1.32</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd 6 mo</td>
<td>42.7%</td>
<td>1.14</td>
<td>0.96-1.36</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd year</td>
<td>44.4%</td>
<td>1.17</td>
<td>1.02-1.33</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 3rd year</td>
<td>45.7%</td>
<td>1.25</td>
<td>1.12-1.41</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>≥ 1 advanced adenoma (AADR)</td>
<td>Attending alone (reference)</td>
<td>8.7%</td>
<td>0.7</td>
<td>1.00</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 1st 6 mo</td>
<td>4.8%</td>
<td>0.52</td>
<td>0.35-0.76</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd 6 mo</td>
<td>9.1%</td>
<td>1.06</td>
<td>0.78-1.44</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd year</td>
<td>9.3%</td>
<td>1.05</td>
<td>0.83-1.31</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 3rd year</td>
<td>8.3%</td>
<td>0.93</td>
<td>0.76-1.15</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>≥ 1 adenoma in right colon (RT-ADR)</td>
<td>Attending alone (reference)</td>
<td>21.1%</td>
<td>-</td>
<td>1.00</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 1st 6 mo</td>
<td>22.3%</td>
<td>0.002</td>
<td>1.05</td>
<td>0.85-1.3</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd 6 mo</td>
<td>23.4%</td>
<td>1.16</td>
<td>0.94-1.42</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd year</td>
<td>23.9%</td>
<td>1.14</td>
<td>0.98-1.34</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 3rd year</td>
<td>24.8%</td>
<td>1.22</td>
<td>1.06-1.39</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>≥ 1 adenoma in left colon (LT-ADR)</td>
<td>Attending alone (reference)</td>
<td>14.8%</td>
<td>0.01</td>
<td>1.00</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 1st 6 mo</td>
<td>16.1%</td>
<td>1.16</td>
<td>0.87-1.41</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd 6 mo</td>
<td>16.4%</td>
<td>1.15</td>
<td>0.91-1.46</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 2nd year</td>
<td>16.8%</td>
<td>1.13</td>
<td>0.94-1.35</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fellow in 3rd year</td>
<td>17.7%</td>
<td>1.23</td>
<td>1.06-1.44</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

1Mantel-Haenszel χ² (non zero correlation); 2From unconditional logistic regression model controlling for age, sex, race, and colon-cleansing preparation quality. ADR: Adenoma detection rate; PDR: Polyp detection rate; AADR: Advanced adenoma detection rate; RT-ADR: Right sided ADR; LT-ADR: Left sided ADR; aOR: Adjusted odds ratio.

in their first six months of training was mainly related to lower detection of large adenomas (3.4% vs 7.9%, P < 0.0001). There were no differences in the detection of adenomas with villous histology or those with HGD and/or cancer. In addition, there was no difference in the detection of right or left sided adenomas. On average, fellows in their first six months of training and attendings detected a similar number of adenomas per colon (0.64 vs 0.61, P = 0.54).

**DISCUSSION**

Our results suggest that the participation of gastroenterology fellows overall in screening colonoscopy may be associated with higher adenoma and polyp detection. In our study, a higher level of detection was manifested both as the number of colonoscopies with at least one adenoma or polyp (ADR and PDR), and the mean number of adenomas and polyps per colon. Furthermore, our findings suggest that fellow’s level of training and experience is directly associated with polyp detection. There was a stepwise increase in adenoma and polyp detection with higher levels of fellow training. Fellows in the first year of training and attendings had similar ADRs and PDRs, while fellows in their second and third year of training had higher values. The higher ADR in the fellows group was seen in both the right and left colon. These findings have clinical significance. Performance of colonoscopies by gastroenterology fellows, who have less experience than attendings, does not appear to negatively affect adenoma and polyp detection in colonoscopy, provided that they are adequately supervised, and may be associated with somewhat greater adenoma and polyp detection. The higher detection of polyps in procedures in which fellows participate could be related to the presence of an additional observer who monitors the screen with the primary endoscopist, and can lead to an increased recognition of small polyps. Previous studies found that endoscopy nurse participation leads to increased polyp detection[13,14]. In addition, participation of fellows could lead to a more focused withdrawal of the colonoscope in which the attending physician actively instructs the fellow to examine behind each colonic fold, thereby increasing the chances of detecting polyps. Our findings also suggest that detection of polyps is a learned skill that continues to improve during fellowship training, highlighting the importance of gaining adequate experience during training to maximize polyp detection.

Our study had several strengths. Unlike previous studies that included non-screening colonoscopies, we focused our analysis on outpatients presenting for the sole indication of colorectal cancer screening. The goal of colonoscopy in patients presenting with clinical indications, such as acute overt bleeding, abdominal pain or constipation, is often to diagnose the etiology of symptoms and not to detect and resect polyps. Polypectomy is often deferred in these patients with acute
indications until their symptoms resolve. In addition, our study included a large number of colonoscopies performed by trainees at different levels of training. Finally, comparisons of colonoscopy quality between attendings alone and fellows are more meaningful when the level of fellow training is considered. We categorized the level of fellow training in a way that reflects their learning curve, as fellows rapidly gain endoscopic skills in the first 6 mo of training, and progress to become more independent endoscopists in their second and third year. Finally, the retrospective nature of this study eliminated the possibility of the “Hawthorne effect”, in which endoscopists alter their behavior as they know that detection rates are being recorded and compared, which is more likely to occur in a prospective study design. One study found that when endoscopists know that their procedures are being recorded for review, they improve the quality of their exam (luminal distension, cleaning of the colon, and length of inspection time), resulting in an increased ADR[15].

Our study had several limitations. It was a retrospective study and it was not possible to accurately describe the degree of fellow participation in colonoscopy. It is possible that attendings performed the withdrawal part of some procedures, and therefore we cannot directly attribute the differences in adenoma and polyp detection to the fellow’s technical skills. We had no data on the colonoscopy insertion and withdrawal times. This would have provided insight about the observed increased polyp detection in second and third year fellows. Longer withdrawal times have been linked to higher adenoma detection rates in screening colonoscopy[16]. It is unclear whether the higher detection rate in second and third year fellows was related to longer withdrawal times or to the technical skill of the fellow combined with the guidance and supervision from the attending, or both. In addition, we did not account for several factors that affect polyp and adenoma prevalence, such as family history of colon cancer, smoking, and aspirin use, the data for which were unavailable. However, we accounted for several important confounders such as age, race, sex, and colonoscopy preparation quality. Given the nature of patient flow through the endoscopy unit where patients are shared between attendings, it is unlikely that there was significant difference in the proportion of patients with a family history of CRC, aspirin use, or other unmeasured confounders between the attending alone and the fellows group. Finally, our study was limited to one training program, and thus may not be generalizable to others.

The finding of a lower AADR in fellows in their first six months of training than in attendings alone was unexpected. This difference was likely primarily attributable to there having been a higher percentage of colonoscopies in which one adenoma ≥ 1 cm was detected in procedures performed by attendings alone. It is unlikely that this was related to fellows underestimating polyp size while they were documenting their procedures early in their training. In general, attendings and fellows discuss findings and write down the sizes and locations of polyps during the procedure, and a final report is entered in the medical record system after the procedure is completed. In addition, attendings sign off on the colonoscopy report and make the necessary changes as they see appropriate. It is reassuring that the ADR itself was not different between fellows in the first six month of training and attendings alone (32.4% vs 30.7%, P = 0.47). Furthermore, there was no difference in the average number of adenomas per colon between these two groups (0.61 vs 0.64, P = 0.54), nor was there a difference in adenoma detection in the right vs the left colon. This suggests that fellows are finding the same number of polyps, though the size of these polyps may be smaller than those found by attendings.

In summary, we found that gastroenterology fellow involvement overall in screening colonoscopy is associated with overall higher ADR and PDR. These higher detection rates were mainly seen in procedures performed by second and third year fellows. Since the AADR was lower in procedures performed with fellows in their first six month of training, increased vigilance in these procedures and an attending joining the fellow in performing a careful withdrawal of the scope, with adequate withdrawal time and careful documentation of polyp size, are indicated. Further studies that document the exact involvement of fellows in the procedure, withdrawal time, and location of polyps would help identify factors related to higher polyp detection rates in more experienced fellows. This would ultimately

---

Table 3  Advanced adenomas and total adenomas per colon found during screening colonoscopies by gastroenterology attendings alone and fellows in their first 6 mo of training; Grady Memorial Hospital, Atlanta, Georgia, July 1, 2009 – July 1, 2015

<table>
<thead>
<tr>
<th></th>
<th>Attending alone</th>
<th>Fellows 1st 6 mo</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 2464</td>
<td>n = 627</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 1 advanced adenoma (AADR)</td>
<td>215 (8.7)</td>
<td>30 (4.8)</td>
<td>0.001</td>
</tr>
<tr>
<td>≥ 1 adenoma ≥ 1 cm</td>
<td>194 (7.9)</td>
<td>21 (3.4)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>≥ 1 adenoma with villous histology</td>
<td>83 (3.4)</td>
<td>14 (2.2)</td>
<td>0.15</td>
</tr>
<tr>
<td>≥ 1 adenoma with HGD and/or cancer</td>
<td>26 (1.1)</td>
<td>4 (0.6)</td>
<td>0.34</td>
</tr>
<tr>
<td>Mean number of APC</td>
<td>0.61</td>
<td>0.64</td>
<td>0.54</td>
</tr>
</tbody>
</table>

1P value from χ² test for categorical variables, and student t test for continuous variables. AADR: Advanced adenoma detection rate; HGD: High-grade dysplasia. APC: Adenomas per colon.
allow us to optimize fellow involvement and training in screening colonoscopy, while maintaining a high quality examination.

REFERENCES
