Factors Associated with Repetitive Strain, and Strategies to Reduce Injury Among Breast-Imaging Radiologists

Atalie C. Thompson, MD, MPH[a,b], Marnie J. Kremer Prill, MD[c], Sandip Biswal, MD[c], Murray Rebner, MD[d], Rachel E. Rebner, BA[e], William R. Thomas, MD[c,f], Sonya D. Edwards, MD[c,g], Matthew O. Thompson, MD[a,h], Debra M. Ikeda, MD[c]

Purpose: To investigate the prevalence of repetitive strain injury (RSI) among breast-imaging radiologists, the factors associated with such symptoms, and strategies to reduce injury.

Methods: In 2012, an anonymous survey regarding RSI and work habits was administered to 2,618 physician members of the Society of Breast Imaging via e-mail. Analysis of 727 (27.8%) de-identified responses was completed using STATA 12.1. Pain levels before and after implementation of digital imaging were compared with the Wilcoxon signed-rank test. The associations between RSI symptoms and work habits were assessed with logistic regression and test for trend.

Results: In the survey 438 of 727 (60.2%) respondents reported RSI symptoms, and 242 of 727 (33.3%) reported prior diagnosis/treatment. Results showed a statistically significant trend for the odds of RSI symptoms to increase with decreasing age ($P = .0004$) or increasing number of daily hours spent working ($P = .0006$), especially in an awkward position ($P < .0001$). Respondents recalled a significant increase in pain level after implementation of PACS, and a decrease in pain after ergonomic training or initiating use of an ergonomic mouse, adjustable chair, or adjustable table ($P < .001$, all comparisons). Only 17.7% (129 of 727) used an ergonomic mouse and 13.3% (97 of 727) had attended ergonomic training. Those with RSI symptoms or prior diagnosis of a Repetitive Strain Syndrome (RSS) were more likely to desire future ergonomic training compared with those without symptoms or injury (odds ratio 5.36, $P < .001$; odds ratio 2.63, $P = .001$, respectively).

Conclusions: RSI is highly prevalent among breast-imaging radiologists nationwide and may worsen after implementation of PACS or with longer work hours. Ergonomic training and ergonomic devices may diminish or prevent painful RSI among radiologists.

Key Words: Repetitive strain injury, breast-imaging radiology, ergonomics

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INTRODUCTION

PACS and digital imaging improve radiologist efficiency and turnaround times [1-3] and save costs [4,5]. But repetitive work at computer workstations can produce repetitive strain injuries (RSIs) [6-12], which have the potential to decrease productivity. As case volumes increase in radiology practices [13,14], it is especially important for radiologists to know how to protect against RSI. The American National Standards Institute (ANSI) has been publishing guidelines for human interactions with computers since 1988 [6], and several recent publications have endorsed both ergonomic work environments and ergonomic training for RSI prevention [2,4,5,7-9,12,15-19].

Despite widespread availability of computer ergonomic guidelines, a single-center survey of departmental

[a]Stanford University School of Medicine, Stanford, California.

[b]University of California, Berkeley, Berkeley, California.

[c]Department of Radiology, Stanford University Hospital, Stanford, California.

[d]Department of Radiology, Beaumont Hospital, Royal Oak, Michigan.

[e]Department of Physical Therapy, Simmons College, Boston, Massachusetts.

[f]Department of Radiology, San Antonio Military Medical Center, San Antonio, Texas.

[g]Department of Radiology, Kaiser Permanente, Greater Southern Alameda Area, Hayward, California.

[h]Department of Internal Medicine, Highland Hospital, Oakland, California.

Corresponding author: Atalie C. Thompson, MD, MPH, 5959 Maple Avenue #1358 Dallas, TX 75235; e-mail: ataliethompson@gmail.com.

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radiologists after PACS installation found that RSI symptoms were prevalent in more than 58% of respondents; 38% had a prior diagnosis of a repetitive strain syndrome (RSS) [20]. In the breast-imaging field, most radiologists read film mammograms on alternators before the 2000 FDA digital mammography approval [21]. After FDA approval, radiologists began to read digital mammograms, ultrasounds, and MRIs on mammography-specific or PACS workstations. These computerized workstations changed the way breast imagers interacted with their environment, raising a new risk for RSI. The goal of our national study was to estimate the prevalence of RSI among breast imagers, to identify factors associated with RSI symptoms, and to assess the prevalence and impact of ergonomic workplace strategies to reduce injury in the breast-imaging reading environment.

METHODS

We developed an anonymous survey instrument for the Society of Breast Imaging as part of a quality assurance project on the prevalence of RSI in breast imagers, incorporating questions based on existing literature about computer workstation ergonomics. In 2013, our institutional review board approved the retrospective analysis of the anonymous cross-sectional survey data.

The survey incorporated questions from a previously published "Ergonomic Survey" instrument, including those regarding: departmental position; current use of digital or analog mammography at work; hours per day spent at a personal computer or PACS workstation; hours per day spent in an awkward position (eg, with wrist bent, bent at the waist leaning forward, kneeling, stooping, squatting, reaching overhead); current RSI (eg, pain, stiffness, soreness, or cramping in any extremity, or the back or neck area related to work tasks); and prior diagnosis of an RSS or overuse syndrome [20]. Age information was grouped into 5-year intervals from $\leq$34 to >65 years. Additional information collected included sites of pain or discomfort related to work tasks, and use of an ergonomic mouse or peripheral input device, adjustable chair, or adjustable table at work. A previously validated visual analog scale consisting of a 10-cm horizontal line that ranged from 0 to 10 was used to assess self-reported pain before and after implementation of a computer PACS workstation and various ergonomic devices or training in the workplace [22].

Our online Qualtrics (www.survey.qualtrics.com) survey instrument was administered by e-mail to the 2,618 physician members of the Society of Breast Imaging in November 2012 and was resent in December 2012 to increase the response rate. A total of 727 (27.8% response rate) anonymous responses were received. Statistical analysis was performed using STATA 12.1 (College Station, TX). The difference in self-reported median pain levels before and after implementation of PACS workstations or various ergonomic devices or training was calculated using the nonparametric Wilcoxon signed-rank test.

In the literature evaluating socioeconomic data, principal component analysis is a statistical technique commonly used to reduce several correlated variables (ie, income, education, health insurance) into a single socioeconomic score index [23]. Because the use of various ergonomic devices was correlated with each other in our study, we applied this analysis to generate an ergonomic score index that accounted for the use of an ergonomic mouse or peripheral input device, adjustable chair, and adjustable table. Univariate and multivariate logistic regression was performed to assess the association between RSI symptoms and the following variables: ergonomic score index, desire for ergonomic training, age, and number of hours spent working in an awkward position or number of hours spent at a computer or PACS workstation. A test for a trend in the odds of RSI symptoms with increasing age or number of hours spent working at a computer or in an awkward position was also calculated. P values and 95% confidence intervals (CIs) were generated using logistic regression or Wilcoxon signed-rank test where applicable. A P value of $<.05$ was considered statistically significant.

RESULTS

Table 1 lists information on the respondents' demographics and work environment. Although 80.3% (n = 584 of 727) reported that a breast-imaging workstation or PACS had been installed, only 17.7% (n = 129 of 727) were using an ergonomic mouse or peripheral input device; only 56.4% (n = 410 of 727) had adjustable tables at work, but adjustable chairs were highly prevalent (n = 667 of 727, 91.7%). A majority of respondents (n = 630 of 727, 86.6%) had not participated in ergonomic training sessions at work but expressed interest in participating (n = 534 of 630, 84.8%).

Table 2 reports the prevalence of RSI symptoms (n = 438 of 727, 60.2%) and diagnoses/treatment (n = 242 of 727, 33.3%), with the most common sites being in the neck and wrists, respectively. In a free-response textbox, respondents were allowed to report additional sites of RSI or prior treatment for a RSS; the elbow was the most common reported site.

A statistically significant trend was found for the odds of current RSI symptoms to increase with decreasing age (P = .0004), greater number of hours spent working each day (P = .0006), and greater number of hours spent in an awkward position (eg, with wrist bent, stooping; P < .0001). A significant trend was found for the association of decreasing age with working $\geq$6 hours (P < .001). Inclusion of all 3 variables in a multivariate model mildly attenuated the association between RSI symptoms and number of hours worked; the association between RSI and either age or hours spent in an awkward position remained statistically significant (Table 3).