Accuracy of students, and radiographers, with and without, mammography post-graduation in interpretation of mammography images

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Purpose

The main purpose of this study was to evaluate the sensitivity, specificity and accuracy of last year students of the Radiography Course and radiographers (with and without, mammography post-graduation) in the interpretation of mammography images. Additionally, we compare the assessments of different groups and the response times of different groups.

Methods and Materials

In accordance to institutional guidelines, the approval of this study was obtained from the review board of the institutions involved.

Sample

From April 2012 to June 2012, 22 participants were selected by convenience sampling due to their affiliation with mammography. The total sample was composed by 2 radiographers with post-graduation in mammography, 4 radiographers without post-graduation in mammography and 16 students in the last year of Bachelor’s course in Radiology at University of Algarve.

Variables

In this study, the independent variables to be considered were age, sex, level of education and professional experience of the participant in mammography technique. The dependent variables to take into account are sensitivity, specificity, diagnostic accuracy and response time of participants (last year students of Bachelor’s course in Radiology, radiographers and radiographers with post-graduation in mammography).

Instruments

A socio-demographic characteristics grid and the ViewDEX® software (Viewer for Digital Evaluation of X-Ray Images) for the interpretation of mammography images by participants were used. Each of the 16 cases was built with the four basic images. After evaluating the images, the 22 participants selected their level of confidence about the presence of abnormal radiological findings in relation to the case.


Procedures

In addition to the socio-demographic grid provided to each participant, a specific login username to ViewDEX® was provided. That specific username allowed the access to an evaluation session of images on ViewDEX®, in which the participant answered if there was a radiological finding and demonstrating the confidence level about the presence of radiological finding as following:

1. Definitely not present;
2. Possibly present (<50%);
3. Probably present (50-90%);
4. Definitely present (> 90%).

After collecting data, we calculated the degree of sensitivity (number of true positives - Figure 1), specificity (number of true negatives - Figure 2) and accuracy for each group of participants [1].

\[
\text{Sensibility} = \frac{TP}{TP + FN}
\]

**Fig. 1**: Sensibility formula.


\[
\text{Specificity} = \frac{TN}{TN + FP}
\]

**Fig. 2**: Specificity formula.

Where: TP is True Positive, FN is False Negative, TN is True Negative and FP is False Positive.

To calculate the sensitivity, specificity and diagnostic accuracy of each group we assumed the values according to the number of radiological findings described in the mammography reports of each patient.

Then, the results were analysed, based in the study variables (dependent and independent), assessing the relationship between obtained values and the training degree of the participants in this study.

The statistical treatment of data was performed using the Statistical Package for Social Sciences (SPSS®) version 20.

Results

Internal Consistency

The internal consistency of the measurement instrument developed and implemented in this study was measured by Cronbach’s alpha. The value of this test is 0.696.

Normality Test

To verify the normality of distribution, we used the nonparametric test of adherence to normality Kolmogorov-Smirnov test. In Table 1 we can observe the values of the test and the respective level of significance.
We can verify, for a confidence level of 95%, that only the responses in cases 1, 4, 5, 10, 11 and 16 are not significant and therefore have a normal distribution. In accordance to this fact, we must use nonparametric tests to perform comparisons.

### Sensitivity, specificity and diagnostic accuracy

Regarding the sensitivity values obtained for the three groups, these were 81% for students, 89% for radiographers without post-graduation and 80% for radiographers with post-graduation. In the case of specificity we obtained 63% in the group of the students, 75% in the group of radiographers without post-graduation and 50% in the group of radiographers with post-graduation in mammography. Finally, the values of diagnostic accuracy obtained for groups of students, radiographers without post-graduation and radiographers with post-graduation were 80%, 88% and 78%, respectively.

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**Table 1: Kolmogorov-Smirnov Test.**

**References:** Radiology, Superior Health School of University of Algarve - Faro/PT

<table>
<thead>
<tr>
<th>Case</th>
<th>Test Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>0.903</td>
<td>0.388</td>
</tr>
<tr>
<td>Case 2</td>
<td>2.357*</td>
<td>0.000</td>
</tr>
<tr>
<td>Case 3</td>
<td>1.557*</td>
<td>0.016</td>
</tr>
<tr>
<td>Case 4</td>
<td>1.285</td>
<td>0.074</td>
</tr>
<tr>
<td>Case 5</td>
<td>1.208</td>
<td>0.108</td>
</tr>
<tr>
<td>Case 6</td>
<td>1.906*</td>
<td>0.001</td>
</tr>
<tr>
<td>Case 7</td>
<td>1.431*</td>
<td>0.033</td>
</tr>
<tr>
<td>Case 8</td>
<td>1.614*</td>
<td>0.011</td>
</tr>
<tr>
<td>Case 9</td>
<td>1.673*</td>
<td>0.007</td>
</tr>
<tr>
<td>Case 10</td>
<td>1.206</td>
<td>0.109</td>
</tr>
<tr>
<td>Case 11</td>
<td>1.324</td>
<td>0.060</td>
</tr>
<tr>
<td>Case 12</td>
<td>1.948*</td>
<td>0.001</td>
</tr>
<tr>
<td>Case 13</td>
<td>1.625*</td>
<td>0.010</td>
</tr>
<tr>
<td>Case 14</td>
<td>2.170*</td>
<td>0.000</td>
</tr>
<tr>
<td>Case 15</td>
<td>1.408*</td>
<td>0.038</td>
</tr>
<tr>
<td>Case 16</td>
<td>1.036</td>
<td>0.234</td>
</tr>
</tbody>
</table>

* Significant for $p < 0.05$
Comparison of mean response between students, radiographers and radiographers with post-graduation

In a confidence interval of 95% the Kruskal-Wallis test (Figure 3) reveal that there are no significant differences between the variables, the value of the test is 3.491 (df = 2 and 2-sided test sig = 0.175). Multiple comparisons were not performed because the overall test does not show significant differences across samples.

![Kruskal-Wallis Test](image)

**Fig. 3:** Kruskal-Wallis Test for comparison of mean response of cases.

**References:** Radiology, Superior Health School of University of Algarve - Faro/PT

Mean response time of students, radiographers and radiographers with post-graduation

The mean response time was 46.9 seconds to the last year radiography students, 59.8 seconds for radiographers without post-graduation and 64.6 seconds to post-graduate radiographers. We can observe that higher the formation in mammography, higher response times are obtained.

Comparison of mean response time between students, radiographers and radiographers with post-graduation
In a confidence interval of 95% the Kruskal-Wallis test (Figure 4) reveal that there are no significant differences between the variables, the value of the test is 5.763 (df = 2 and 2-sided test sig = 0.056). Multiple comparisons were not performed because the overall test does not show significant differences across samples.

![Independent-Samples Kruskal-Wallis Test](image)

**Fig. 4:** Kruskal-Wallis Test for comparison of mean response time.

**References:** Radiology, Superior Health School of University of Algarve - Faro/PT

**Conclusion**

According to Moran & Warren-Forward [2], radiographers presented sensitivity values between 57% and 97% and specificity between 63% and 80% with respect to the reading of mammograms, being the experienced radiographers in mammography, more valuable in the interpretation of mammograms, leading to an improvement of the exploration provided in a screening program. The results of this study are in agreement with the results obtained in the study mentioned above with respect to sensitivity and specificity, which are similar in the three cases.

Zijta et al. [3], whose objective was to evaluate the diagnostic accuracy of radiographers compared with radiologists, in the detection of colorectal lesions on magnetic resonance imaging colonography, concluded that radiologists and radiographers had similar sensitivities in patients with lesions # 10 mm (65% vs. 50%) and that for lesions # 10 mm, the specificity of radiologists and radiographers was 96% and 73%, respectively. These
results are line up with the specificity results obtained in the group of post-graduated radiographers. All other values, in the present study, are below 70%. Regarding the sensitivity, in the study mentioned above the values obtained was below the values obtained in our study.

Bradley, Rajashanker, Atkinson, Kennedy & Purcell [4] in an investigation aiming to evaluate if radiographers experts in intravenous urogram examinations have the same interpretation accuracy of radiologist registrars, was found that diagnostic accuracy in the group of radiology specialists registrars of 1st year was 76%, in the combined group of radiology specialists registrars of the 2nd, 3rd and 4th years was 88% and in the group of radiographers experts in intravenous urogram was 92%. These values are in agreement with the accuracy obtained in the group of radiographers without post-graduation (88%), this being the highest. In the other two groups, the values were below 88%.

Other studies also demonstrated that the evaluation of images, when performed together with other professionals (radiologists, junior doctors and/or other radiographers well experienced) promote an evaluation with higher accuracy, whereas the study by Kelly, Rainford, Gray & McEntee [5], supports this fact and concluded that the results obtained with the help of junior doctors with radiographers exceed the sum of the parts, showing that both professionals perform better when they work together than when proceed to the evaluation of examinations individually.

The sensitivity, specificity and diagnostic accuracy varies in each group, but there were not found, significant differences for each group. Obtaining these values can be influenced by the small sample size.

Regarding the differences in the responses obtained for each group, it is possible to conclude that despite the formation, the mean responses of groups are quite approximate. Regarding the average response time for each group we can observe that if the participant has more training, greater is the mean response time.

The results also indicate that it is required a larger sample for perform a comparison more reliable and that provide a greater homogeneity between the study groups.

References


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