Validation of a chronic obstructive pulmonary disease questionnaire

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Abstract

Background
Epidemiological surveys using questionnaires are increasingly used as the sole method for diagnosing chronic obstructive pulmonary disease (COPD) in at-risk population. The performance of such questionnaires may be affected by cultural differences and translation may alter outcome; therefore, it may not be possible to use questionnaires validated in settings different to ours. In Sudan, the epidemiology of COPD remains unknown. This study was conducted to test the validity of a COPD diagnosis questionnaire in a cohort of Sudanese patients with coronary artery disease (CAD). The questionnaire has the potential for future use in Sudan.

Methods
We studied consecutive adults with catheter diagnosed CAD recruited from two cardiac centers. All patients completed the COPD diagnosis questionnaire and performed spirometry. The questionnaire was translated in Arabic by the doctors who conducted the interview. COPD was diagnosed if patients score placed them in the high likelihood zone of having COPD or if their forced expiratory volume in the first second (FEV1) was less than 80% predicted. The validity of the questionnaire was tested, using spirometry diagnosed COPD as gold standard, by calculating sensitivity, specificity, negative and positive predictive values.

Results
Forty patients were studied. Their mean ± SD age was 45 ± 6.8 years. The calculated sensitivity, specificity, positive and negative predictive values of the questionnaire were 36%, 69%, 31% and 74% respectively.

Conclusion
In this group of patients with CAD the COPD questionnaire yielded results on validity testing comparable to results from similar questionnaires.

Key words: COPD; questionnaire; validation; spirometry.

Introduction
The gold standard for the diagnosis of COPD is spirometry\(^{(1)}\). Nevertheless, despite frequent advocacy for spirometric screening\(^{(2,3)}\), spirometry is underused\(^{(4)}\). For epidemiological research validated questionnaires are increasingly used as the sole method for diagnosing COPD\(^{(5,6)}\). Such questionnaire surveys may be conducted by screening the general population, or directed to specific risk groups among whom the prevalence of COPD is known to be high. Many reports have shown that there is increased prevalence of COPD in patients
with CAD specially that they share a common risk factor namely cigarette smoking\(^{(7-9)}\). It is well known, however, that the outcome of such questioners may be affected by cultural differences among the different population groups in which they are used and since most of them are not written in Arabic the translation process may affect performance\(^{(10,11)}\). Therefore, it may not be possible to extrapolate tests of validation conducted elsewhere to our settings. In this study, we tested the validity of a COPD questionnaire that used a simple scoring system to enhance practicality in a cohort of Sudanese patients with catheter diagnosed CAD\(^{(5)}\). The questionnaire has the potential to be used for future surveys and research in Sudan where the epidemiology of COPD is unknown.

**Methods**

This is a cross sectional study that was conducted during the period August 2007 to January 2008 inclusive. It included all consecutive adults with catheter diagnosed CAD recruited from two cardiac centers in Khartoum, Sudan: Sudan Heart Centre and Elshaab Teaching Hospital. Ethical approval for the study was obtained from the administrative and ethical committee of Sudan Heart Centre and all patients gave informed consent to take part in the study. All patients were interviewed and completed a COPD diagnosis questionnaire\(^{(5)}\). The detailed questionnaire is found in the paper by Price et al\(^{(5)}\). In summary, the questionnaire used a 16-point scoring system divided into five categories: age presented in 10-year groups; body mass index presented in three groups; smoking intensity expressed as pack-years; symptoms including sputum production, cough, shortness of breath and wheeze; and history of allergies. Each point was given a specific numerical score. The questionnaire was translated in Arabic by the doctors who conducted the interview (F.M. and T.EY.) and a score was calculated for each patient. A COPD diagnosis was assigned to all individuals whose total score (19.5 or more) placed them within the high likelihood zone of having obstruction in a receiver operator characteristic (ROC) curve\(^{(5)}\). All patients performed spirometry using an electronic spirometer: Spida 5, Micromedical, England. The maneuver was explained to each subject and the best of three values of forced expiratory value in the first second (FEV1) was recorded. Height was measured to the nearest centimeter and weight was recorded to the nearest kilogram. Predicted values for FEV1 were calculated as those for blacks. Study diagnoses were based on guidelines developed by the American Thoracic Society and European Respiratory Society task force: standards for the diagnosis and treatment of patients with COPD\(^{(12)}\). A diagnosis of COPD was assigned to persons with FEV1 less than 80 % predicted\(^{(12)}\). The validity of the questionnaire was tested comparing questionnaire performance to spirometry, regarded as the gold standard, by calculating sensitivity, specificity, negative and positive predictive using standard statistical equations\(^{(13)}\).

**Results**

A total of 40 patients with catheter diagnosed CAD were studied. All 40 patients completed the questionnaire and performed spirometry. Table 1 shows the demographic and clinical characteristics of the 40 patients studied. The mean ± SD age was 45 ± 8.6 years and half of them had COPD diagnosed by either questionnaire or spirometry.
Table 1: Demographic and clinical characteristics of the 40 patients studied.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age mean ± SD</td>
<td>45 (8.6)</td>
</tr>
<tr>
<td>Male</td>
<td>27 (67.5%)</td>
</tr>
<tr>
<td>Female</td>
<td>13 (32.5%)</td>
</tr>
<tr>
<td>Current or previous smokers</td>
<td>18 (45%)</td>
</tr>
<tr>
<td>COPD (diagnosed by spirometry or questionnaire)</td>
<td>20 (50%)</td>
</tr>
</tbody>
</table>

Table 2 shows those with COPD diagnosed by either spirometry (regarded as the gold standard) or questionnaire among the 40 patients studied. Of the 13 patients with COPD diagnosed by questionnaire four had FEV1 less than 80% and were, therefore, true positives; the remaining nine had FEV1 80% or more and were false positives. Of the 11 patients with COPD diagnosed by spirometry seven had total scores less than 19.5 and were false negatives. Twenty patients did not have COPD by either spirometry or questionnaire and were, therefore, true negatives.

Table 2: COPD diagnosed by either questionnaire or spirometry (regarded as gold standard) among the 40 patients studied (TP = true positive; FP = false positive; FN = false negative; TN = true negative).

<table>
<thead>
<tr>
<th>COPD diagnosed by questionnaire</th>
<th>COPD diagnosed by spirometry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TP = 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FP = 9</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>FN = 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TN = 20</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows the calculated sensitivity and specificity for the questionnaire using spirometry as the gold standard.

Table 3: Calculated sensitivity, specificity, positive and negative predictive values for the 40 patients who performed spirometry (TP = true positive; FP = false positive; FN = false negative; TN = true negative)\(^{(38)}\).

<table>
<thead>
<tr>
<th></th>
<th>Equation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>TP / (TP + FN)</td>
<td>36%</td>
</tr>
<tr>
<td>Specificity</td>
<td>TN / (FP + TN)</td>
<td>69%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>TP / (TP + FP)</td>
<td>31%</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>TN / (TN + FN)</td>
<td>74%</td>
</tr>
</tbody>
</table>
Discussion

The results of this study have shown that the questionnaire we used has performance, in our settings, comparable to that of other respiratory screening questionnaires. In COPD, for example, retrospective analyses using data from the Third National Health and Nutrition Examination Survey in the United States of America achieved sensitivities ranging 54 to 86% and specificities from 40 to 71%\(^{14,15}\). For these patients the PPV ranged from 20 to 69%, whereas the NPV ranged from 64 to 94%\(^{14,15}\). Symptom-based screening tools for asthma achieved sensitivities from 38 to 80% in adults and 23 to 86% in children, with specificities ranging from 64 to 99% and 55 to 100% in adults and children respectively\(^{16,17}\).

We opted to test the validity of a questionnaire that adopted a simple scoring system and is practical for further use in Sudan\(^{5}\). We see at least two potential applications for the current questionnaire: Firstly, case finding application by detection of COPD among specific risk groups. This is useful in conducting epidemiological surveys. The epidemiology of COPD in Sudan is not known because no surveys were conducted. In recent years it has been noted that there is an increase in the incidence and prevalence of non communicable diseases in developing countries, and the World Health Organization classifies these countries as double burden regions\(^{18}\); the best studied example is CAD\(^{18,19}\). Many studies have shown that a significant proportion of patients with CAD have concomitant COPD\(^{7,9}\). Therefore, it is likely that we will see a surge in COPD prevalence. This highlights the need for formal epidemiological surveys for COPD.

We feel that the questionnaire we validated will be a useful mean to this end. Secondly, the questionnaire has a clinical application by improving efficiency of COPD diagnosis in at risk groups who present with respiratory symptoms; this is mainly used as a differential diagnosis tool and help clinicians to decide who to refer for lung function testing.

Finally, it is known that different clinical populations are likely to have different baseline prevalence of COPD. Since the questionnaire scoring system we used is based on positive and negative predictive values, which are sensitive to baseline prevalence, questionnaire performance will to be different in these populations. The positive predictive value increases as prevalence increases while the negative predictive value decreases with increasing prevalence. It is, therefore, worth noting that questionnaire performance may be different if used in populations with dissimilar prevalence rates. However, these differences are likely to be small.

In conclusion this study has shown that the questionnaire we used has performance comparable to other questionnaires that adopted the same approach. We see a real potential for using this questionnaire for further epidemiological surveys and research in Sudan.
References


تقييم صلاحية إستمارة تشخيص الإعتلال الرئوي الإنسدادي المزمن

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ملخص

خلفية: السحب الوبائي باستخدام الإستمارات، يتزايد كميسكة منفردة لتشخيص الإعتلال الرئوي الإنسدادي المزمن في مجتمعات تحت الخطر. إن اداء هذه الإستمارات يتأثر بالظروف الثقافية وربما تغير الدرجة النتايج السحب وقد لا يكون بالإمكان استخدام إستمارات تم تقييم صلاحيتها التشخيصية في ظروف مختلفة عن وقتها في السودان. إذ لا تزال الوضع الوبائي للاعتلال الرئوي الإنسدالي المزمن غير معروف. أجريت هذه الدراسة لإختصار مدى صلاحية إستمارة تشخيص الإعتلال الرئوي الإنسدالي المزمن في مجموعة من المرضى السودانيين مصابين بإعتلال الشرايين الرئوية ودائم هناك حاجة لاستخدام هذه الإستمارة مستقبلًا في السودان.

طرق البحث: لقد تم بدراسة أشخاص بالعدين مصابين بإعتلال شرايين ناجية تم تشخيص حالتهم بالسكتة القلبية في مركزين لعلاج أمراض القلب. قام جمع المرضى بعمل إستمارة تشخيص الإعتلال الرئوي الإنسدالي المزمن وإجراء قياس وظيفة الرئة وتحدي تلك أن نجوم إستمارة هي اللغة العربية تحت وصاية الأطفال الذين قاموا بإجراء الإستمارة. أعتبر الشخص مصاب بالإعتلال الرئوي الإنسدالي المزمن إذا أقرر عدد من نقاط تجعل إحتمال إصابته عالياً أو كان الحجم الزحفي في الثانية الأولى أقل من 80% من الموقع. تم إختبار صلاحية الإستمارة بقارتها بنتائج التشخيص المبني على قياس وظيفة الرئة وبسيطة قياسية أو مقاياس ذهبية لتشخيص الإعتلال الرئوي الإنسدالي المزمن و ذلك بحسابات إحصائية (الحساسية، النوعية، الفهم والوضوح السطحي، الإجابة).

النتائج: تم إجراء الدراسة في أربع مناطق متوسطة أعمال 45 عاماً (الانحراف المعياري 6.8). كانت نتائج حساب الحساسية، النوعية والأهمية الموقعة

المنطقة في مرضي الشرايين الناجية أعطى الإستمارة المستخدمة لتشخيص الاعتلال الرئوي الإنسدالي المزمن نتائج لاختبار الصلاحية يمكن مقارنتها بنتائج إستمارات مشابهة.

مفتاح الكلمات: الإعتلال الرئوي الإنسدالي المزمن، استمارة، وظيفة الرئة.