The French version of the HSCL-25 has now been validated for use in primary care

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Title

THE FRENCH VERSION OF THE HSCL-25 SCALE: A CROSS-VALIDATION STUDY SET AGAINST THE PSE-9, IN PRIMARY CARE DAILY PRACTICE.

Abbreviated Title

The HSCL-25 French version, study validation.

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Abstract

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Background

The Hopkins Symptom Checklist in 25 items (HSCL-25) helps to assess depression in Primary care. This self-administrated questionnaire is validated, reliable and ergonomic. A patient is considered 'depressive' if a score > 1.75 is obtained. We have translated it into French.

The aim of this study was to validate the test characteristics of the HSCL-25, in its French version (F-HSCL-25), by comparing the results with the Present State Examination-9 French version (F-PSE-9) results.

Method

Outpatients from three French General Practice settings (rural, semi-rural and urban) were recruited: approximately 20,000 outpatients among 17 GPs. Two groups were formed: F-HSCL-25 ≥1.75 and F-HSCL-25 <1.75. In order to obtain two balanced groups, a different method of randomization was chosen for each group. The F-PSE-9 was randomly administered to 1 in 2 patients in the F-HSCL-25 ≥1.75 group, and to 1 in 16 in the (much larger) F-HSCL-25 <1.75 group. The diagnostic performance was assessed and the test results obtained from both groups were compared with their F-PSE-9 results.

Results

Of the 1126 patients who completed the F-HCL-25, 886 joined the F-HSCL-25 <1.75 group and 240 the F-HSCL-25 ≥1.75 group. The overall prevalence of depression, using the F-HSCL-25, was 21% in these medical practices. The diagnostic performance of the F-HSCL-25 versus the external criteria (F-PSE-9) were as follows: Positive Predictive Value (PPV) 69.8%, Negative Predictive Value (NPV) 87%; Sensitivity 59.1%, and Specificity 91.4%.

Conclusion

The F-HSCL-25 is an appropriate diagnostic tool for depression in primary care in France due to its high specificity and high NPV. This pilot study will be extended throughout Europe, however, preliminary evidence suggests that the HSCL-25 is a suitable diagnostic tool for depression in primary care.

Keywords: Depression – Hopkins symptom Checklist 25 items – Validation studies – Psychometrics

Introduction

Major depression affects 4.4% of the world population [1-3]. Estimates of prevalence in the general population vary in Europe but are currently around 25% [4-6] . Furthermore, the

prevalence is twice as high for women [7]. A prevalence increase of more than 18% was observed between 2005 and 2015 [8]. Within the French population, prevalence is estimated to be between 5% and 12% [9]. Currently, nearly 8 million French people have experienced, or will experience, depression during their lifetime [10]. Depression has a significant impact on emotional, social and occupational life and is a major risk factor for suicide [11].

The general practitioner (GP) diagnosis for major depression has a high specificity but a low sensitivity in routine care but, as GPs can also offer efficient follow-up, primary care is a good place to organize treatment [12,13]. This syndromic disorder is not easy to diagnose due to the wide variety of ways in which it may be presented [14]. In most European countries, GPs are the first, and often the only, physicians to take care of depressed patients but they generally have little time [15,16]. A fast, efficient and sensitive tool with a reasonable specificity and negative predictive value, would add value and save time, thereby improving performance management in primary care.

From the many diagnostic tools available for combined European research studies, the HSCL-25 has been selected, using a European consensus procedure, based on a systematic review of the literature. It combines high quality reliability, effectiveness and ergonomics with a conceptual connection to the DSM [17,18].

The HSCL-25 is a short-form diagnostic tool derived from HSCL-90 [19,20]. This is a comprehensive, systematized, semi-directed, clinical self-administered questionnaire [28][29].

The specificity is robust: between 0.78 to 0.88, the reliability (Alpha de Cronbach) is between 0.87 to 0.97 [21-24] . The HSCL-25 short length self-administered format is perfectly suited for use in busy primary care settings with many competing demands. It may represent a practical instrument to alert French GPs to potentially depressive or anxious symptomatology.

The score is based on 25 questions divided into two sub-sections related to the presence and intensity of symptoms of depression and anxiety experienced during the previous week. Patients select one of the four responses for each item on a 4-point Likert scale, ranging from 1 (strongly disagree) to 4 (completely agree). Completing the questionnaire takes between 5 and 10 minutes. The final score is calculated by dividing the sum of the scores of all the items by 25 (the final score ranges from 1.00 to 4.00). A diagnosis of Major Depression, defined as "a case requiring treatment," is generally above a threshold of 1.75 [25].

The HSCL-25 was translated into French using a well-established procedure in primary care, involving a forward/backward translation based on a Delphi procedure, combined with a cultural check to maintain linguistic and semantic reliability (appendix 1) [26,27].

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In 1993, Nettlebladt & al. evaluated the accuracy of the HSCL-25 as a primary care diagnostic questionnaire in Sweden [30]. They carried out a study in six Swedish primary healthcare centers in two districts, one rural and one semi-urban, to validate the HSCL-25 against the PSE-9 and establish a cut-off.

A cut-off of 1.55 indicated a patient at risk, but a cut-off of 1.75 specified that the patient needed treatment. A cut-off of 1.75 gave a sensitivity of 73%, a specificity of 76%, a Positive Predictive Value (PPV) of 58% and a Negative Predictive Value (NPV) of 86% [30].

The HSCL-25 is not currently used by French GPs, but is a potentially promising tool. The aim of this project, inspired by the Nettlebladt study, was to determine the external efficiency of the HSCL-25 French version (F-HSCL-25) in French general practice by comparing it with the Present State Examination-9 French version (F-PSE-9), a widely accepted semi-structured clinical interview used extensively in psychiatry [29].

Method

Study design

A quantitative cross-validation study of the F-HSCL-25 in an adult French general practice population was carried out by the research team of the Soins primaires, Santé Publique, Registre des tumeurs de Bretagne Occidentale (EA 7479 SPURBO). It was a comparative, non-inferiority, multi-centered, survey. The study team constituted of two physician researchers, three GP trainees specifically trained in psychiatric assessment using the PSE-9 and using the CATEGO algorithms [29], a psychiatrist, a statistician, a GP research network of 20 GPs, a Data Manager and a Research Coordinator. The psychiatrist of Brest CHRU trained the GP trainees in psychiatric assessment and confirmed the validity of the clinical diagnoses. A multidisciplinary research network supported the study.

The inclusion period was 20 weeks. The duration of participation for each patient was 1 week. The study was conducted between June 2015 and February 2016.

Participants

The study was carried out in northern Finistère (Brittany, France) in three study centres (family practice offices affiliated to SPURBO). The population was a mix of patients from urban, semi-rural and rural environments. In the waiting room, before their primary care appointment, patients were given a leaflet explaining the study, an F-HSCL-25 scale and a consent form. Participants were recruited spontaneously to ensure the representativeness of the recruited population, after they had read the explanatory notice and completed the F-HSCL-25 (paper version).

Inclusion criteria

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The patients needed to be adults (over 18 years). Patients had to give their written informed consent to participate. They completed the F-HSCL-25 self-assessment questionnaire and submitted it to the study team.

Exclusion criteria

To avoid possible cases of puerperal depression, which requires specific management, women with a reported pregnancy were not included in the study [31][32][33]. Also excluded were adults consulting for administrative purposes, patients known to be schizophrenic or having related disorders and patients requiring emergency care.

Sample size

Patients were placed in an HSCL+ group or an HSCL- group according to their scores : F-HSCL-25 score ≥1.75 (or HSCL+) and F-HSCL-25 score <1.75 (or HSCL-). To obtain two balanced groups for final analysis, one in two patients in the HSCL+ group were randomly administered an PSE-9 interview, and one in sixteen patients in the HSCL- group were administered an F-PSE-9. This process ensured the two groups were as comparable as possible.

The delay between interview and inclusion had to be between one week and one month in order to prevent bias in the results of the PSE-9 interview. This was particularly important where an F-HSCL-25 score of ≥1.75 initiated treatment by the GP.

These ratios assume a prevalence of depression between 5% and 12% which gives reasonable precision in estimating diagnostic performance [9]. At least 45 patients were needed per group to ensure a power of 80% in order to detect a difference of at least 50% in the number of people with a PSE-9+ result in the HSCL+ group, compared with 20% with a PSE-9+ result in the HSCL- group.

This required the recruitment of 810 patients. To compensate for those lost to follow-up, the research team decided to include 1100 patients.
The randomization was achieved independently, via computer software, excluding any human intervention in the selection.

Ethics

The entire study obtained the ethical agreement of the PPC (Protection of Persons Committee). Patients had to give their written, ethical consent to participate. (ID RCB: n°2014-A01790-47; reference CPP: CPP Ouest VI 872; [1 SEP]N° Clinical Trial.gov: NCT02414711).

All patients with a score of ≥ 1.75 were informed by the investigating physician, that they could be depressed, in order to initiate the necessary care with their GPs, according to ethical principles and the ethical consent form.

Statistical analysis

The data was analysed by the Data Management Unit of the Brest University Hospital (Brest CHRU), and the statistical analyses were carried out using SAS software version 9.4 and R version 3.2.0. The tests were carried out with an alpha risk of 5 %.

Descriptive Analysis: Quantitative variables are expressed as means, standard deviations, 25, 50 and 75 quantiles, minimum and maximum values. Qualitative variables are expressed as ratios and percentages.

Comparative Analysis: Univariate comparisons were carried out using relevant standard tests (Student's, Wilcoxon's, chi-squared and Fisher's tests).

External HSCL-25 validation: PPV and NPV were directly calculated, according to formulas based on a contingency table, but this was not possible for sensitivity and specificity. Due to a different artificial sampling step for the PSE-9 positive/negative patients groups, prevalence was not respected. The corrected proportions for the contingency table were calculated, taking into account the number of positive/negative patients and the number of included patients. The whole calculation is in appendix 2. For each parameter, 95% confidence intervals were computed by bootstrap using R library boot.

Results

Clinical and demographic features

The Flow diagram (Fig. 1) shows the number of included patients who had filled in the HSCL-25, whether they were randomised to the PSE-9 group or not, and also shows those who took the PSE-9.

Fig 1. Flow diagram

(insert flow diagram)

1134 patients were selected: 2 patients were wrongly included (a pregnant patient and a patient with related disorders) and 6 were duplicates.

1126 patients filled in the HSCL-25 questionnaire. The two groups were created.

HSCL- group:

- 886 patients were randomized according to a ratio of 1/16.
- 831 did not take the PSE-9 test, the study ended for these patients

HSCL+ group:

- 240 patients were randomized according to a ratio of 1/2.
- 122 did not take the PSE-9 test, the study ended for these patients.

Prevalence pitfall

A prevalence established by the F-HSCL-25 of 21.3% was identified among patients consulting their GPs. At the beginning, the sample size was calculated according to prevalence between 5% and 12%. This led to some imbalance in the number of PSE-9 assessments being carried out in the HSCL+ and HSCL- groups.

The study included 1126 French outpatients consulting their GP. Patients were aged between 18 and 94 years. The median age was 59 years and the gender ratio (F/M) was 1.49, Table 1.

Table 1. Patients' characteristics

Variable		Overall Population (N=1126)	Group F-HSCL-25 <1.75 (N=886)	Group F-HSCL-25 ≥1.75 (N=240)	inter-group comparisons
Age					t(408.53)=3.66
	Mean +/- SD	55.62 +/- 18.4	56.61 +/- 18.6	51.98 +/- 17.0	
	Median (q1-Q3)	59 (42 – 70)	61(42-72)	53(38 - 66)	P<0.001
	min-max	18-94	18-94	19-91	
Gender					Chi(1)=25.24
	Male	452 (40.14%)	390 (44.02%)	62 (25.83%)	
	Female	674 (59.86%)	496 (55.98%)	178 (74.17%)	P<0.001

*inter-group comparisons obtained by Student t test for quantitative variables and Chi² test for qualitative variables

Contingency

55 patients in the HSCL- group had to take the PSE-9. 9 were lost to follow-up; 118 patients in the HSCL+ group had to take the PSE-9. 22 were lost to follow-up. Contingency data are expressed in Table 2, Table 3 and Appendix 2.

Table 2. Contingency table HSCL-25/PSE-9, before prevalence correction

		PSE-9		TOTAL
		« Positive »	« Negative »	
HSCL-25	« Positive »	67	29	96
	« Negative »	6	40	46
TOTAL		73	69	142

Table 3. Estimated contingency table HSCL-25/PSE-9, after prevalence correction

		PSE-9		TOTAL
		« Positive »	« Negative »	
HSCL-25	« Positive »	21.12 (15%)	9.14 (6%)	30.26
	« Negative »	14.57 (10%)	97.16 (68%)	111.73
TOTAL		35.69	106.3	142

Outcomes

According to a prevalence of 21.3% (including prevalence corrections) and a cut-off of 1.75, accuracy data gave the following efficiency features, Table 4:

Table 4. Efficiency features

	Value	IC95% *
PPV	69.79	[60.61 – 78.98]
NPV	86.96	[77.22 – 96.69]
Sensitivity	59.17	[43.59 – 80.85]
Specificity	91.40	[88.49 – 94.06]

*Obtained by bootstrap

Discussion

Main Findings

F-HSCL-25 adequately assessed major depression. It demonstrated a capacity to recognise a major depressive episode with a PPV greater than 60%. The specificity of 91% indicated efficiency in identifying significant depression in primary care settings. It is a useful first-line ergonomic diagnostic tool with a low number of false positive patients. The GPs' high depression diagnosis specificity, combined with this tool's efficiency in excluding non-depressive patients with a low margin of error, may serve to identify patients with depressive symptoms much more rapidly.

General discussion

Compared to the study by Nettlebladt, this study resulted in a lower sensitivity (59% versus 76%), it had a higher specificity (91% versus 73%). The prevalence of conspicuous

psychiatric morbidity was lower (21% versus 33%). Previous studies showed similar results in terms of sensitivity and specificity [30,34].

A cut-off point of 1.75 was established for case definition in the original English version. According to Nettlebladt & al., choosing a lower cut-off point (1.55) tended to raise the sensitivity (89%), but also gave higher false positives (43%), making it less accurate. Screening capacity is improved at the expense of diagnostic capacity. Due to the average sensitivity rate and the high specificity in the French study, the HSCL-25, with a cut-off point of 1.75, is valuable in diagnosing patients who require a specific treatment for depression.

The use of a different randomization for each group: a ratio of 1/2 for HSCL+ group, a ratio of 1/16 for HSCL- group, could explain the differences in terms of prevalence, sensitivity and specificity compared with Nettelbladt's study. Nevertheless, the difference in randomization ratios allowed us to balance the number of F-PSE-9 patients in our groups more closely.

A more recent Swedish study by Lundin & al. also examined the concordance between the HSCL-25 scale score and the DSM-IV depression and anxiety disorders using a well-known semi-structured psychiatric interview (SCAN) as a criterion standard [35]. It differs from the previously mentioned studies due to its large sample (8613 patients recruited) based on a general population although not a medical outpatients' population. It found that both the depression and anxiety scales of HSCL-25 performed well in detecting their respective DSM-IV disorders. A combined (global) scale also performed efficiently. Nettlebladt's diagnostic performance, with the cut-off >1.75, showed a higher sensitivity (67.1%), a lower specificity (78.4%), a much weaker PPV (29.8%) but a better NPV (94.6%) than this survey. Our results are comparable with the survey by Lundin and are better than the survey by Nettelbladt.

These results merit comparison with the external validity data of other tools for use in primary care. HSCL-25 like the HADS, is built along two axes: anxiety and depression. HADS has been tested in primary care. It has a higher sensitivity and specificity compared to HSCL-25 (between 0.84 and 0.96) [36]. The ergonomics of this tool seemed more complex to the researchers who preferred the HSCL-25 [18].

The PHQ-9 has a sensitivity between 0.77 and 0.88 and a specificity between 0.88 and 0.94 [37][38]. It is built on the PRIME-MD, not the DSM.

The tools are numerous; researchers will make their choices according to their objectives. Systematic reviews or Meta analyses would then be very useful [39,40].

Strengths

The strength of this study and its relevance for GPs lies in the fact it is specifically set in primary care.

Several types of data quality procedures were followed which increased the reliability of the results, including the appointment of a designated DRCI data manager at the Brest CHRU. Furthermore, the expertise of the stakeholders in the team was balanced to make data collection secure. A stratified randomization was used to ensure both satisfactory statistical power and affordable logistics.

Women accounted for 60% of the sample. The mean age was 59 years. These sample features were comparable to other studies in primary care settings (51 years). The sample characteristics are close to European population-based norms which make it feasible to generalize from these results [4].

Selection bias

A prevalence of 21.3% was identified among patients consulting their GPs. At the beginning of the study, the sample size was calculated according to a prevalence of 5% to 12% in the general population. This study focused on a population which consulted the GP [41]. This prevalence was close to that in Hesbacher's study, but lower than those in Nettelbladt's and Golberg's studies [8,30,34] .

Overestimation of the prevalence is possible due to the internal structure of the HSCL-25. This may occur when anxiety and depression are considered separately; however, it is consistent when anxiety and depression are combined [42,43]. In research, the high NPV and specificity, which enable us to eliminate the false positives, also limit this bias. Therefore, physicians should take this into account in their clinical work. To increase the sensitivity, the HSCL-25 could be combined with a screening tool such as the PHQ-2 [44]. With Brittany currently having the highest rate of suicide in France, it is possible that the depression rate in this region may be higher than in France as a whole [45].

This difference has been taken into account in the statistical analysis. The number of subjects was reassessed during the study because of the unexpected distribution of the patients in the two groups. The number of subjects necessary to guarantee the statistical power of the study did not depend on this prevalence but on the minimum number of patients placed in each subgroup. This imbalance does not influence the statistical power of the global study. There were 31 (17.9%) lost to follow-up out of the 173 subjects chosen to take the PSE-9 assessment. Other patients replaced them in accordance with the original randomization method. The protocol had entirely anticipated this bias by allowing for 20% to be lost to follow-up.

Information bias

The electronic observation book (eCRF) guaranteed the anonymity of the subjects, allocating them a number and keeping only the first two letters of the surname and first name and the date of birth. The eCRF allowed monitoring and enabled traceability of the study. A research assistant checked the validity and consistency of the information between the paper questionnaires and the eCRF. All collected data were compiled into a numeric database. At the end of the study, all information was checked one last time and the database was frozen before statistical work to prevent any information bias.

Confusion bias

All responses collected during the PSE-9 interviews were retrospectively analysed under the psychiatrist's supervision to avoid misinterpretations and to limit any confusion bias.

Implications

The F-HSCL-25 performs well in detecting symptoms of depression in French primary care and similarly, with its high sensitivity, provides suitable estimates for clinical research purposes. Its possible use by healthcare professionals with basic diagnostic skills in mental health could be an advantage in multidisciplinary research. As this study was carried out among unselected adult patients, further investigations could examine the performance of the HSCL-25 in its French version. This could include specific samples in primary care, for example, in student populations or in elderly patients, as has already been carried out in Norway and in Sweden respectively [43,46].

Conclusion

The F-HSCL-25 demonstrated a capacity to detect symptoms of a major depressive episode. This useful first-line ergonomic diagnostic tool, combined with the GPs' high depression diagnosis specificity, may serve to identify patients with depressive symptoms much more rapidly. The validation of this reliable and efficient tool throughout Europe, in its translated version, with the same study design, could be of significant epidemiological importance and facilitate the development of more collaborative research within Europe on the subject of depression.

List of abbreviations and definitions

Brest CHRU: Centre Hospitalier Régional Universitaire de Brest

CIC: Centre d'Investigation Clinique

CPP: Comité de Protection des Personnes

DSM IV / V: Diagnostic and Statistical Manual of Mental Disorders 4th / 5th Edition

DUMG: Département Universitaire de Médecine Générale

DRCI: Délégation à la Recherche Clinique et à l'Innovation

eCRF: electronic case report

F-HSCL-25: French version HSCL-25

GPs: General Practitioners

HSCL-25: Hopkins Symptom Checklist - 25 items

PHQ-2: Patient Health Questionnaire 2 items

PSE-9: Present State Examination in its 9th version

Se: Sensitivity

Sp: Specificity

SPURBO = EA 7479 SPURBO: Soins primaires, Santé Publique, Registre des Tumeurs de Bretagne Occidentale

NPV: Negative Predictive Value

PPV: Positive Predictive Value

Ethics Approval and consent to participate

The entire study obtained the ethical agreement of the CPP (Protection of Persons Committee) of the University Hospital of Brest; (ID RCB: n°2014-A01790-47; Référence CPP: CPP Ouest VI 872; N° enregistrement Clinical Trial.gov: NCT02414711). All study participants signed a consent form.

Consent to publish

All authors of the manuscript have read and agreed its content and are accountable for all aspects of the accuracy and integrity of the manuscript in accordance with ICMJE criteria.

They confirm that the article is original, has not already been published in a journal, nor is it currently under consideration by another journal.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have no financial or other competing interests to declare.

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Authors' contributions section

NP designed the study, led meetings, collected data, drafted the article and submitted it for publication. LRJY designed the study, supervised meetings, collected data and reviewed the article. GLM designed the study, participated actively in training trainees, and reviewed the article. GF performed statistical analysis. BS reviewed the article. LFB reviewed the article. MT reviewed the article and gave final approval for the version to be published. VJ participated actively in the study and reviewed the article. VMH designed the study, reviewed the article, and gave final approval for the version to be published. VRP designed the study, reviewed the article, and gave final approval for the version to be published.

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Appendix 1: HSCL-25 Original version / HSCL-25 French version

ITEMS N°	HSCL-25 ORIGINAL VERSION	F-HSCL-25
	Choose the best answer for how you felt over the past week	Veuillez choisir la réponse qui décrit le mieux comment globalement vous vous sentiez toute la semaine dernière
1	Being scared for no reason	Vous avez peur sans raison
2	Feeling fearful	Vous vous sentez effrayé
3	Faintness	Vous avez une sensation d'étourdissement
4	Nervousness	Vous vous sentez nerveux
5	Heart racing	Vous avez l'impression que votre cœur bat anormalement vite
6	Trembling	Vous avez la sensation de trembler
7	Feeling tense	Vous vous sentez tendu
8	Headache	Vous avez des maux de tête
9	Feeling panic	Vous vous sentez paniqué
10	Feeling restless	Vous vous sentez agité
11	Feeling low in energy	Vous manquez d'énergie
12	Blaming oneself	Vous ressentez une sensation de culpabilité
13	Crying easily	Vous pleurez facilement
14	Losing sexual interest	Vous ressentez un désintérêt pour la vie sexuelle

15	Feeling lonely	Vous avez une sensation de solitude
16	Feeling hopeless	Vous vous sentez désespéré
17	Feeling blue	Vous avez le cafard
18	Thinking of ending one's life	Vous avez pensé à mettre fin à votre vie
19	Feeling trapped	Vous vous sentez pris au piège
20	Worrying too much	Vous vous inquiétez trop
21	Feeling no interest	Plus rien ne vous intéresse
22	Feeling that everything is an effort	Tout est un effort pour vous
23	Worthless feeling	Vous avez le sentiment d'être bon à rien
24	Poor appetite	Vous avez perdu l'appétit
25	Sleep disturbance	Votre sommeil est perturbé

Appendix 2: Calculation of the F-HSCL-25 predictive values

Table 2. Contingency table HSCL-25/PSE-9, before prevalence correction

		PSE-9		TOTAL
		« Positive »	**« Negative »**	
HSCL-25	**« Positive »**	67 (69.79%)	29 (30.21%)	96
	« Negative »	6 (13.04%)	40 (86.96%)	46
TOTAL		73	69	142

We could calculate PPV and NPV directly from the contingency table, according to the following formulas:

PPV = TP / (TP + FP) = 67 / (67 + 29) = 0.70

NPV = TN / (TN + FN) = 40 / (40 + 6) = 0.87

However, the sampling step was artificial. It was determined by the protocol to improve the feasibility of the study, as 1/16 (HSCL-) and 1/2 (HSCL +) patient. The prevalence is not respected.

We could not apply the contingency table directly, according to the formulas for Se and Sp

Corrective formulas to obtain Se and Sp

The probability of the test being positive or negative from the contingency table should be calculated as follows:

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The number of positive tests (HSCL ≥ 1.75) divided by the number of patients included: P (HSCL +) = (HSCL +) / N

The number of negative tests (HSCL <1.75) divided by the number of patients included: P (HSCL-) = (HSCL-) / N

N = 1126

P(HSCL+) = (HSCL+) / N = 240 / 1126 = 0.21

P(HSCL-) = (HSCL-) / N = 886 / 1126 = 0.79

Now we are able to calculate the corrected proportions for the contingency table:

Proportion of True Positive = PPV * P (HSCL +) = 0.70*0.21 = 0.15

Proportion of True Negative = NPV * P (HSCL-) = 0.87*0.79 = 0.68

Proportion of False positive = (1-PPV) * P (HSCL +) = (1-0.7)*0.21 = 0.06

Proportion of False Negative = (1-NPV) * P (HSCL-) (1-0.87)*0.79 = 0.10

Table 3. Estimated contingency table HSCL-25/PSE-9, after prevalence correction

		PSE-9		TOTAL
		« Positive »	« Negative »	
HSCL-25	**« Positive »**	21.12 (15%)	9.14 (6%)	30.26
	« Negative »	14.57 (10%)	97.16 (68%)	111.73
TOTAL		35.69	106.3	142

The corrected number on the contingency table can then be calculated by multiplying by the number of patients who have passed the PSE (142 outpatients).

Then directly apply the calculation formulas:

Se = TP / (TP + FN) = 21.12 / (21.12+35.69) = 0.59

Sp = TN / (TN + FP) = 97.16 / (97.16 + 9.14) = 0.91

The calculation of the NPV and the PPV from the initial or modified contingency table were, of course, identical.

This could be expressed concisely and applied rapidly by using the following corrective formulas directly:

Se = PPV ∗ P(HSCL+) / [P(HSCL+) ∗ PPV] + [P(HSCL−) ∗ (1−NPV)]

Sp = NPV ∗ P(HCSL−) / [P(HSCL+) ∗ PPV] + [P(HSCL−) ∗ (1−NPV)

Se= Sensitivity; Sp= Specificity; P: Prevalence; PPV = Positive Predictive Value; NPV = Negative Predictive Value; P(HSCL+) = Patient HSCL+ frequency; P(HSCL−) = Patient HSCL− frequency