BrainCheck

BrainCheck Screen™ Validation

In a previous clinical study involving 99 individuals, BrainCheck Screen correctly identified patients with cognitive impairment with 92% sensitivity and 74% specificity. BrainCheck Screen's high sensitivity ensures minimal missed impaired cases, making it an effective pre-screening tool.

Included Tests

The BrainCheck Screen (BC-Screen) includes three subtests: Immediate/Delayed Recognition and Digit Symbol Substitution, which take approximately 3-5 minutes to complete.

Immediate and Delayed Recognition

These assessments screen for deficits in the memory domain. First, Immediate Recognition displays 10 words, one at a time. The test taker is then shown either a distractor word or a target word (20 trials) and must decide whether each was present in the original word list.

The Delayed Recognition takes place after the Digit Symbol Substitution. On each trial the test taker is again presented with either a distracted word or a target word and asked whether each word was present in the original word list without seeing the list again. The number of correct answers is used as the raw score for both tests.

Digit Symbol Substitution

This assessment measures processing speed. Participants must match an arbitrary correspondence of symbols to digits; when presented with a new symbol, they input the corresponding digit. This is a continuous performance task in which the test taker must make as many correct matches as possible within a one minute test period. The median reaction time across trials is used as the raw score.

BC-Screen's impression of the test taker's cognitive status is based on the total impression score of the three sub-tests. For each sub-test, the raw score is first converted into a standardized score using data from the corresponding normative group based on the test taker's age and testing device. This standardized score measures how many normative standard deviations below or above the normative mean the raw score is. The impression score of a sub-test is calculated based on its standardized score. (Fig. 1)

Impression Score	Criteria
0	Standard Score ≥ -1
1	-2 ≤ Standard Score < -1
2	Standard Score < -2

Fig. 1: Sub-test impression score calculation

The total impression score is the sum of the impression scores of all sub-tests, and the impression of BC-Screen will be determined using a cut-off value of 1:

Total impression score ≥ 1
Possibly impaired (further assessments needed)

Total impression score = 0
Unimpaired

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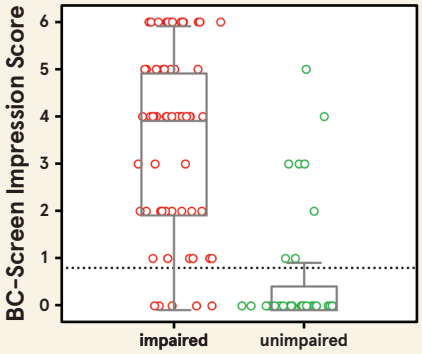
Validation

BC-Screen has been validated using the dataset from our previous clinical study (Ye et al., 2022). This dataset consisted of 99 individuals diagnosed to have normal cognition (N=35; indicated by subjective cognitive complaint or no diagnosis of cognitive impairment, some of which were self-reported), mild cognitive impairment (N=22; representing both amnestic and nonamnestic subtypes), or dementia (N=42; including dementia due to AD, frontotemporal dementia, vascular dementia, Lewy body dementia, mixed dementia, or atypical AD).

We evaluated the accuracy of BC-Screen in differentiating impaired subjects (those with mild cognitive impairment or dementia; N=64) from unimpaired subjects (those with normal cognition; N=35). We find high sensitivity/specificity and high agreement between BC-Screen impression and clinical diagnosis. (Fig.2)

(A)



(B)

Clinical Diagnosis

BC-Screen Impression

	Impaired	Unimpaired	Total
Impaired	TP=59	FP=9	68
Unimpaired	FN=5	TN=26	31
Total	64	35	99

Fig.2: Clinical Diagnosis

(A) BC-Screen impression score for the Impaired and Unimpaired groups;

(B) Number of subjects classified as Impaired and Unimpaired by BC-Screen (rows) and by clinical diagnosis (columns).

Legend

TP = True Positive
FP = False Positive
TN = True Negative
FN = False Negative

Sensitivity

Sensitivity (Se) measures BC-Screen's ability to correctly identify an individual with the disease as positive:

Se = TP/(TP+FN) = 92%

For screening purposes, BC-Screen's high sensitivity is as desired. It means few actual impaired cases will be missed. This high sensitivity comes with a reasonable specificity (not many individuals without the disease screened positive), which shows that BC-Screen is highly effective as a pre-screening tool.

Specificity

Specificity (Sp) measures BC-Screen's ability to correctly identify an individual without the disease as negative:

Sp = TN/(TN+FP) = 74%

Positive and Negative Percentage Agreement

Positive Percent Agreement (PPA) and Negative Percent Agreement (NPA) are other measures of agreement between BC-Screen and clinical diagnosis. PPA and NPA are similar to sensitivity and specificity, respectively, but depend on the prevalence of impaired cases in the study sample:

PPA = TP/(TP+FP) = 87% (proportion of individuals screened positive are actual impaired cases)

NPA = TN/(TN+FN) = 84% (proportion of individuals screened negative are not impaired)

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