A Screening Instrument to Measure the Prevalence of Neurological Disability in Resource-Poor Settings

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Key Words
Neurological disability, prevalence · Resource-poor settings · Africa · Community-based study · Neurological impairment

Abstract
Background: Very little is known about the prevalence of neurological morbidity in Africa. Much of this is due to the difficulty in performing epidemiological surveys in these settings. A screening instrument to measure neurological disease in resource-poor settings was designed by the World Health Organization in 1981, but several problems with it have subsequently been recognized. Methods: We created a new screening instrument that addressed problems with the original instrument identified by prior investigators, and that included questions to identify diseases of public health significance and broad neurological syndromes. This new instrument was tested in an outpatient setting in Moshi, Tanzania. We compared the sensitivity and specificity of the new instrument to the original 1981 WHO instrument. Results: We tested the survey on 128 participants. Of these, 63 had neurological diagnoses, 21 had pain-only diagnoses and 44 had no neurological diagnoses. The survey was well received by all the participants. A nonmedical interviewer was trained to administer and interpret a simple neurological examination without difficulty. The median time to administer the instrument was 13 min (interquartile range 10–17 min). The sensitivity of the new instrument improved that of the WHO instrument from 98.4 to 100%, but the difference was not statistically significant ($p = 0.44$). However, the specificity significantly improved from 29.2 to 61.0% ($p = 0.001$). Conclusions: We have developed a screening instrument to measure the prevalence of neurological morbidity in resource-poor settings. It was shown to be highly feasible, highly sensitive, and more specific than the existing WHO instrument.

Introduction

In 2003, the Institute of Medicine outlined 6 strategies to reduce the burden of brain disorders in the world. Strategy 4 included the directive to ‘Conduct … epidemiological research to monitor the incidence, prevalence and disease burden of brain disorders in developing countries’ [1]. However, to date no one knows the true prevalence of neurological disorders in the people of Sub-Saharan Africa. One of the major reasons for this is the current lack of a suitable tool for its proper measurement in these settings. In addition, the existing estimates may
underestimate the true burden. The Global Burden of Disease Study (GBDS) estimated that neurological diseases make up only 4.5% of the burden of disease in low-income countries. However, that study reported on only 13 specific neurological ‘diseases’ thus excluding those suffering from neurological impairment caused by other diseases (e.g. HIV or TB infection) [2, 3]. Several recent hospital-based studies from Africa document that neurological disorders account for 18–25% of medical admissions, suggesting a much heavier burden of disease in the community than reported by the GBDS [4–7]. The only three population-based assessments of adult neurological disease in Africa predated the HIV epidemic [8–10].

It is evident that updated prevalence data on all-cause neurological morbidity in African communities is needed. There is evidence that the burden of neurological disease in Africa will increase [11]. We have recently reported that 23 African nations, with a population totaling 270 million people, had only 1–4 neurologists per country. Eleven nations, with a population totaling 26 million, had no neurologists [12]. There are less than 0.01 neurosurgeons per 100,000 people in Africa, compared to 1.02/100,000 people in Europe [13]. Clearly, the western model of neurological care cannot be copied in most African nations. Rational decisions on the level of neurological education for primary caregivers, as well as the long-term requirements for specialists (i.e. neurologists, neurosurgeons) need to be based on the local prevalence of neurological disorders.

In 1982, Schoenberg [14] first discussed the inherent difficulties in measuring the prevalence of neurological disorders in resource-poor settings where accurate census data are often unavailable and the number of physicians with neurological expertise is limited. He and co-workers developed a two-phased approach to community surveys where nonmedical personnel used a screening instrument to first screen the population, followed by a referral to a neurologist for examination if the individual screened positive [15].

This screening instrument must be both feasible and valid. It must be accepted by the community, easily applied by a nonmedical trainee, and brief. It must be sensitive enough so that all participants with neurological disorders are detected for referral to the neurologist, but specific enough so as not to overwhelm these physicians. An excessive number of false positives could make the survey logistically impossible to perform [16]. This latter point is the greatest challenge for epidemiologists in resource-poor settings.

In 1981, the Neurosciences Program of the World Health Organization (WHO) developed a screening instrument to identify individuals with cerebrovascular disease, epilepsy, extrapyramidal disorders, peripheral neuropathy, intracranial neoplasms, and migraine headache [17]. It consisted of a series of 15 questions on neurological symptoms followed by 7 simple tasks to assess the neurological examination, and was considered the criterion standard for neuroepidemiological surveys for many years (Appendix 1). However, many subsequent investigators have identified problems with this instrument [18–28]. It was also designed before there were data on which diseases are of greatest public health significance in these settings.

In addition, the instrument was designed to assess for the prevalence of defined diseases. Another approach, however, is to assess for the prevalence of disability without making a definite diagnosis [29]. With the lack of laboratory support, a final diagnosis is often difficult to make in resource-poor settings. This syndrome-based approach is more practical and would include those suffering from neurological impairment as a result of non-neurological diagnoses such as HIV, TB and unknown diagnoses.

We used the original WHO instrument as a template to create a new instrument to address these issues. Specifically, our new instrument was designed to address the gaps identified by previous investigators, to include questions to detect the diseases of public health significance, and to identify those with neurological impairment from non-neurological or unclear diagnoses.

**Methods**

A literature review was performed to collect data on the deficiencies identified in the 1981 WHO instrument by subsequent investigators. Multiple deficiencies were identified [10, 18–28]. To identify diseases of public health significance in Africa, we used the GBDS. Although the GBDS has been criticized as being uncertain in sub-Saharan Africa, it nonetheless gives one a sense of the overall burden of different diseases in different regions of the world [30, 31]. The most burdensome neurological diseases in terms of mortality and morbidity in Africa in 2002 were in order cerebrovascular disease, tetanus, epilepsy, trypanosomiasis, meningitis and migraine. When considering morbidity alone (as would be measured in a prevalence survey), this list changes to epilepsy, migraine, cerebrovascular disease, dementia, meningitis and low back pain [2].

A revised instrument was designed to meet the following criteria: suitability for non-medically trained staff, acceptability to the population, speed of application, sensitivity to identify neuro-
logical morbidity in Africa, and specificity to minimize cost and anxiety of false positives.

With these criteria we created a new draft instrument by expanding the original version. This included new items to increase sensitivity for detection of parkinsonism, stroke, epilepsy and peripheral neuropathy, and to identify tetanus, trypanosomiasis, meningitis, dementia, nonmigrainous headache, low back pain, and broad neurological syndromes.

We tested the instrument at the Kilimanjaro Christian Medical College (KCMC) in Moshi, Tanzania in June/July, 2007, and in February, 2008. Ethical approval was obtained from the London School of Hygiene and Tropical Medicine, the KCMC ethics review committee, and the National Institute for Medical Research in Tanzania. The instrument was translated into Swahili by a Tanzanian medical officer, back translated into English by a nonmedical person, corrected and then retranslated into Swahili to assure accuracy. All participants were adult (≥15 years) outpatients of the KCMC, and gave signed consent. Participants were identified as neurological cases by the attending neurologist at the KCMC, and were recruited through the outpatient neurology and physical therapy clinics. The diagnosis of the attending neurologist was used as the gold standard for the diagnosis of each patient. Participants were identified as potential controls if they carried no neurological diagnosis from their attending physician, and were recruited through other outpatient clinics. All participants (cases and controls) were asked to enroll after completing their outpatient visit. It is possible that some of the controls agreed to participate because they suspected a neurological condition. Therefore, a neurologist (J.H.B.) did a complete neurological examination on each potential control to confirm there was no neurological disease. In 22 participants originally recruited as controls, a neurological diagnosis was made and their status was changed to a ‘case’. Two interviewers were hired from the local community to apply the instrument. One was a nurse, and one had no medical background. Both spoke fluent Swahili and English. Formal training on the instrument was performed over 1 day, but both had full supervision by a neurologist throughout the project.

After 50 participants were enrolled in the study, an initial assessment of the questions’ specificity was performed. Several questions were recognized as having poor specificity, and the instrument was amended. Specifically, subquestions were added. If the participant responded affirmatively to the question, the subquestions were asked. At least one of the subquestions would need to be answered clinically positive in order for the original question to remain affirmative. There were 78 participants who received the final draft instrument, but all 128 received the original WHO version.

After completion of the study, each participant with a neurological diagnosis was classified into 1 of 6 syndromes: myelopathy/peripheral, ataxia/extrapyramidal, epileptic, hemispheric, diffuse and pain-only disorders. Those with more than one diagnosis were classified into more than one syndrome. Each question was then assessed for its sensitivity in detecting a case if appropriate for that syndrome (e.g. ‘Have you ever lost consciousness?’ was assessed for sensitivity in detecting epileptic cases but not myelopathic cases). Each question was also assessed for specificity in the controls. All questions with a low specificity (<90%) were evaluated for corrective action (table 1).

<table>
<thead>
<tr>
<th>Question</th>
<th>Specificity %</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Have you ever lost consciousness?’</td>
<td>76.9</td>
<td>Adding subquestions increased specificity to 90.3%</td>
</tr>
<tr>
<td>‘Have you ever had a time when you didn’t know where you were?’</td>
<td>89.1</td>
<td>Adding subquestions increased specificity to 97.6%</td>
</tr>
<tr>
<td>‘Have you ever had weakness in your arms or legs for more than a day?’</td>
<td>89.2</td>
<td>Adding subquestions increased specificity to 95.6%</td>
</tr>
<tr>
<td>‘Has there been any deterioration of your memory within the last five years?’</td>
<td>63.0</td>
<td>Adding subquestions increased specificity to 93.0%</td>
</tr>
<tr>
<td>‘Have you ever had a time of slurred speech, seeing double and losing your balance while walking?’</td>
<td>89.0</td>
<td>Question eliminated</td>
</tr>
<tr>
<td>‘Have you had pain in your face?’</td>
<td>86.1</td>
<td>Question eliminated</td>
</tr>
<tr>
<td>‘Do you fail to sleep at night, then sleep during the day?’</td>
<td>74.9</td>
<td>Question eliminated</td>
</tr>
<tr>
<td>‘Do you get headaches?’</td>
<td>80.5</td>
<td>Question not considered when selecting participants for neurologist referral</td>
</tr>
<tr>
<td>‘In the last year, have you ever had back pain that caused you to stay in bed all day instead of doing your normal daily activities?’</td>
<td>82.9</td>
<td>Question not considered when selecting participants for neurologist referral</td>
</tr>
</tbody>
</table>

Table 1. Corrective action on questions with low specificity
Table 2. Summary of the 128 participants in the survey

<table>
<thead>
<tr>
<th>Description</th>
<th>Neurodiagnosis (n = 63)</th>
<th>Pain only (n = 21)</th>
<th>No neurodiagnosis (n = 44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age, years</td>
<td>45</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>Age range, years</td>
<td>16–87</td>
<td>21–68</td>
<td>21–80</td>
</tr>
<tr>
<td>Gender (female: male)</td>
<td>33:30</td>
<td>17:4</td>
<td>20:24</td>
</tr>
</tbody>
</table>

Figures are medians, with interquartile ranges in parentheses.

Table 3. Time required to administer the instrument

<table>
<thead>
<tr>
<th>Description</th>
<th>Neurological diagnosis</th>
<th>Pain only</th>
<th>No neurological diagnosis</th>
<th>All participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time for history, min</td>
<td>10 (8–12)</td>
<td>7 (6–10)</td>
<td>7 (6–8)</td>
<td>8 (6–11)</td>
</tr>
<tr>
<td>Time for exam, min</td>
<td>6 (5–7)</td>
<td>5 (4–5)</td>
<td>5 (4–6)</td>
<td>5 (4–6)</td>
</tr>
</tbody>
</table>

The sensitivity and specificity of the new instrument were measured similarly. However, the two questions on pain were not included in the sensitivity or specificity analysis. Statistical comparison between the two surveys was performed using a χ² analysis.

Results

Table 2 gives a summary of the participants in the survey. There were a total of 128 participants (70 females, 58 males). Initially, 62 of the participants were recruited as cases and 66 were recruited as controls. However, 22 of the recruited controls were found to have a neurological diagnosis (12 headache, 4 low back pain, 3 peripheral neuropathy, and 1 each essential tremor, herpes zoster, and epilepsy), and their status was changed to a neurological or pain-only diagnosis.

In total, there were 71 neurological diagnoses amongst 63 participants. There were 27 myelopathy/peripheral cases (10 peripheral neuropathy, 2 each of conus lesion and hearing loss, and 1 each of facial palsy, trigeminal neuralgia, VI palsy, Guillain-Barré syndrome, old polio, carpal tunnel syndrome, herpes zoster, muscular dystrophy, myasthenia gravis, cervical myelopathy, HIV myelopathy, syringomyelia, stiff-person syndrome); 13 ataxia/extrapyramidal cases (4 parkinsonism, 2 each of chorea, ataxia and cerebellar degeneration, 1 each of cerebellar TB abscess, dystonia and essential tremor); 13 hemispheric disorders (9 stroke, and 1 each of congenital lesion, frontal contusion, hydatid cyst, and unknown hemiplegia); 13 epilepsy and 5 diffuse disorders (1 each of encephalopathy, hydrocephalus, amnestic syndrome, dementia and cerebral palsy). In addition, there were 11 pain diagnoses amongst these 63 participants (7 migraine, 3 other headache, 1 cervical spondylosis).

In total there were 23 diagnoses amongst 21 participants with pain-only diagnoses (11 migraine, 6 other headache, 6 mechanical low back pain). There were 44 participants with no neurological or pain-only diagnosis.

Table 3 lists the median and first to third quartile range of the time required to perform the symptom question (history) section and the simple tasks (exam) section of the final version of the instrument by the interviewer (78 participants). Those sections administered by the neurologist were not included in these calculations.
One hundred and twenty-four participants were asked: ‘Did any of the questions or any part of the examination bother you?’ All 124 answered ‘no’.

The neurologist observed the non-medically trained interviewer perform the examination section of the instrument on 23 participants while both recorded their results independently and simultaneously. In 9/9 (100%) participants with no neurological diagnosis, there was perfect agreement on every examination question. In 11/14 (78.6%) participants with neurological diagnoses, there was perfect agreement on every examination question. In 3/14 (21.4%) of these participants, there was disagreement on a total of 4 examination questions. On three occasions, the interviewer incorrectly called a finding abnormal [touch (E3), hypoglossal nerve (E8), facial muscles (E9)] when the neurologist felt it was normal. On one occasion, the interviewer felt the vibration sense (E4) was normal when the neurologist felt it was abnormal.

Table 4 lists the sensitivity and specificity of the two instruments. Because the instrument was changed in the middle of the study, fewer participants were given the final version than the 1981 WHO version. Therefore, the results for the WHO instrument are calculated for the 128 participants given that instrument, and the results for the final instrument are given for the 78 participants who received that instrument. The sensitivity of the final instrument improved that of the WHO instrument from 98.4 to 100%, but this difference was not statistically significant (p = 0.44). The sensitivities of both versions are very high. However, the specificity of the new version significantly increased that of the WHO version from 29.2 to 61.0% (p = 0.001).

### Table 4. Sensitivity and specificity of the two screening instruments

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981 WHO Instrument¹</td>
<td>98.4 (62/63)</td>
<td>29.2 (19/65)</td>
</tr>
<tr>
<td>95% CI</td>
<td>95.3–100</td>
<td>18.1–40.3</td>
</tr>
<tr>
<td>Final instrument²</td>
<td>100 (37/37)</td>
<td>61.0 (25/41)</td>
</tr>
<tr>
<td>95% CI</td>
<td>46.1–75.9</td>
<td></td>
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</tbody>
</table>

¹ The 1981 WHO instrument was tested on 63 cases and 65 controls.
² The final instrument was tested on 37 cases and 41 controls.

Discussion

Discussion of Methods

In creating the final version of the instrument, 3 questions from the 1981 WHO version (on loss of consciousness, alteration of consciousness and weakness) and 1 new question (on dementia) were found to have low specificity. Subquestions were added and the specificities increased substantially. The questions all had high sensitivity. The addition of the subquestions decreased the sensitivity of the individual questions but did not decrease the sensitivity of the final instrument overall, as cases answered affirmatively to more than 1 question.

Three questions however had both low specificity and low sensitivity, and were thus eliminated from the final instrument. A question on brainstem signs of stroke did not detect stroke patients well. A question on facial pain was often poorly understood by participants. A question on sleep disruption designed to detect trypanosomiasis was poorly specific. There were no participants with trypanosomiasis to measure sensitivity. From a public health perspective, this disease leads to high mortality rather than morbidity, and thus in a prevalence survey would not be of high significance. We felt we could eliminate the question and still detect those surviving with the disease through the questions addressing parkinsonism.

We considered those with pain-only diagnoses as ‘controls’ in the analysis because we defined a ‘control’ to be an individual who should not be referred to the physician for a further diagnostic evaluation. Because headache and low back pain can be diagnosed by the screening instrument, tremendous resources can be saved by not referring these individuals for further diagnosis. Osuntukun et al. [32] used this technique when diagnosing migraine headache from survey questions alone in Nigeria. However, many patients with migraine answer affirmatively to other questions (e.g. sensory loss, weakness) and thus our specificity rates dropped. In fact, if ‘controls’ were defined as only those with no neurological or pain-only disease, the specificity rates would have increased for both surveys (to 50% for the 1981 WHO version, and 69% for the final version). However, headache and back pain are extremely common disorders and will overwhelm the referral phase of any prevalence survey. We prefer to make the diagnosis without referral, and thus preserve scarce physician resources, acknowledging that by doing so, the instrument’s specificity will appear lower.
Discussion of Results

We have shown our screening instrument to be highly feasible in resource-poor settings. 124/124 participants expressed no discomfort with any question or part of the examination. Although this was a selected population as they consented to be in the study, we do not expect any cultural difficulty in the field, as the questions and examination are both nonintrusive.

It is not feasible in these settings to have medical personnel administer an instrument like this. Nonmedical personnel are more readily available, know the geography of the community, and are more likely to be accepted by the population so as to increase participation rate. They would also require lower salaries than medically trained staff, another nontrivial issue in these settings.

This study revealed no difficulties in training a local person to administer either the history section or examination section of the instrument. The interviewer with no medical background developed an excellent ability to interpret the neurological examination. There were 368 examination findings amongst the 23 participants that were scored by both the interviewer and investigator. Of these, there were only 4/368 (1.1%) discrepancies. It was the investigator’s impression that 1 day of formal training, followed by 2 weeks of direct supervision and critique would be adequate to train an average interviewer.

In spite of the increased length of the final instrument, the times to administer the history questions and perform the examination were both very reasonable. A median time of 15 min to complete the full instrument per participant can be anticipated. In the field, this should actually be shorter as most of the participants will have no neurological disorder, with a shorter administration time.

The final instrument maintained the high sensitivity of the 1981 WHO instrument. Sensitivity in the field may be lower, as outpatients are already aware of their disease. We believe that the new instrument will actually have a higher sensitivity in the field than the WHO instrument to detect neurological morbidity. It includes more items to detect parkinsonism, stroke, epilepsy and peripheral neuropathy. It includes new items to detect dementia, meningitis, nonmigrainous headache, low back pain, trypanosomiasis and tetanus. It also includes items to detect dyskinesias, and expands on items for hemispheric and brainstem signs so as to identify those with undiagnosed neurological syndromes.

The final instrument significantly improved the specificity of the 1981 WHO instrument, but its specificity still remains relatively low. We considered removing additional questions to improve specificity but this may decrease sensitivity. In addition, of the 16 false-positive controls, 10/16 (62.5%) had >2 false-positive questions. There was not one question that was consistently answered falsely positive.

On the other hand, the low specificity may also be reflective of the fact that the controls were recruited at outpatient clinics. By definition, they have some particular illness, and thus have somatic complaints more than the average person in the community. The specificity of the instrument in a community may be higher.

Conclusions

We have developed a screening instrument to measure the prevalence of neurological morbidity in resource-poor settings, and have shown that it maintains the high sensitivity of the original criterion standard instrument, while significantly improving the specificity and thus greatly improving the feasibility of performing prevalence studies in these settings. In addition, it is designed to cover more diseases of public health significance, and broad neurological syndromes to detect neurological morbidity from nonneurological diseases (e.g. HIV/AIDS).

The instrument must now be used in a population-based setting to provide evidence that will assist in the more appropriate allocation of scarce resources in these settings. The importance of such information is likely to increase as demographic shifts in resource-poor settings result in an increasing burden of chronic disability.

Acknowledgements

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Appendix 1: 1981 Original WHO Instrument

Q1 Have you ever lost consciousness?  
Q2 Have you ever had episodes where you lost contact with your surroundings?  
Q3 Have you ever had episodes of shaking of your arms or legs which you could not control?  
Q4 Is your speech normal?  
Q5 Have you had episodes of pain in the face?  
Q6 Has your face or part of your face ever been paralyzed for more than 24 hours?  
Q7 Have you ever had weakness in your arms or legs for more than 24 hours?  
Q8 Have you been unable to walk properly?  
Q9 Have you ever had loss of sensation or abnormal sensation affecting your arms and legs, lasting more than 24 hours?  
Q10 Have you ever suffered from headache?  
Q11 Do you suffer from severe headaches, chiefly on one side of the head, which come on from time to time?  
Q12 In association with these headaches, do you suffer from visual disturbances: e.g. black spots or zigzag lines in front of your eyes?  
Q13 In association with these headaches, do you suffer from nausea or vomiting?  
Q14 In association with these headaches, do you suffer from weakness or numbness in the limbs that lasts less than a few days?  
Q15 Do these headaches occur only when you have a febrile illness?  

E1 Hold both arms above head for 30 s.  
E2 Pick up matchstick from ground.  
E3 Close your eyes. Feel cloth sample. Is it smooth or rough?  
E4 Put your hands out in front of you. Close your eyes. Touch your nose with the right index. Repeat it using your left.  
E5 Walk heel to toe along the white line (2 meter cloth).  
E6 Stand with both feet together.  
E7 Close your eyes and stand still for 15 s (only if able to perform E6).  

Appendix 2: Final Screening Instrument

Q1 Have you ever lost consciousness?  
A Do you fall when this happens?  
B Do you bite your tongue when this happens?  
C Do you lose control of your bladder when this happens?  
Q2 Have you ever had a time when you didn’t know where you were?  
A Was it more than once?  
B Do you experience abnormal smells or sensations when this happens?  
C Does it only occur during a fever?  
Q3 Have you had times of violent shaking of the limbs?  
Q4 Have you had tremors that lasted longer than a day?  
Q5 Have you had other unusual movements lasting longer than a day?  
Q6 Have you ever had weakness in your arms or legs for more than a day?  
A Was it only on one side of your body?  
B Do you still have the weakness right now?  
C Were you paralyzed?  
Q7 Have you ever had loss of feeling or odd feelings in your arms or legs for more than a day?  
A Was it only on one side of your body?  
B Do you still have this loss of feeling right now?  
C Did you lose complete feeling?  
Q8 Have you ever lost vision to one side?  
Q9 Have you ever had a time when you couldn’t speak, or couldn’t understand what people were saying to you?  
A During this time, did you lose vision to one side?  
B During this time, did you have weakness on one side of the body?  
C During this time, did you lose feeling on one side of the body?  
Q10 Have you ever had any change in your speech?  
Q11 Has your face or part of your face been paralyzed for more than a day?  
Q12 Do you hear well?  
Q13 Do you walk well?  
A Do you use a cane/walking stick or wheelchair?  
B Do you fall to the ground?  
Q14 Do you get headaches?  
A In the last year, have you ever had a headache that made you not do your normal daily activities?  
B Is the headache mostly one-sided?  
C With these headaches do you have problems seeing, like seeing black spots, stars or zigzag lines?  
D With these headaches, do you get nauseous, or vomit?  
E With these headaches, do you get weak or numb in the arms or legs?  
F Do these headaches occur only when you have a fever?  
Q15 In the last year, have you ever had back pain that caused you to stay in bed all day instead of doing your normal daily activities?  
Q16 In the last year, have you had any times of fever with loss of consciousness?  
Q17 In the last year have you been admitted to the hospital?  
A What was the cause?  
B Where were you admitted?  
Q18 Do you have any problems using your hands, such as with using a spoon, stirring or buttoning?  
A Is it because of pain?  
Q19 Has there been any deterioration of your memory within the last five years?  
A Does it stop you from doing your job, or normal activities?  
Q20 Have you ever had a stroke?  
Q21 Have you ever had epilepsy, fits or seizures?  
Q22 Have you ever had meningitis?  
Q23 Have you ever had tetanus?  
Q24 Have you ever had any disease that affected your brain, spinal cord or nerves?  

E1 Hold both arms above head for 30 s.  
E2 Pick up pen from ground.  
E3 Close your eyes. Feel cloth sample. Is it smooth or rough? (Right and left separately)  
E4 Can you feel the vibration of the tuning fork on your ankle? (Right and left separately)  
E5 Put your hands out in front of you. Hold for 15 s. Close your eyes. Touch your nose with the right index. Repeat it using your left.  
E6 Tap your right thumb and index finger together rapidly. Repeat with your left.  
E7 Look at my nose. Am I holding up one or five fingers? (Test four quadrants)  
E8 Stick your tongue straight out.  
E9 Smile widely for me.  
E10 Follow my fingers with your eyes.  
E11 Repeat the following sentence ‘Yuma has built a house.’  
E12 Close your eyes. Can you hear the paper crinkling? (Right and left separately)  
E13 Walk four meters  
E14 Walk heel to toe along the line (only if able to do E13).  
E15 Stand with your feet close together.  
E16 Stand with your eyes closed for 15 s (only if able to do E15).
References


