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ORIGINAL ARTICLE

Utility and Effectiveness of Computerised Motion Sensitivity Screening Tests in Rural Onchocercal Community Survey

Utilité et Efficacité des Tests de dépistage de la Sensibilité du Mouvement Traités par ordinateur dans une enquête Communautaire de l'Onchocercose en milieu Rural

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ABSTRACT

BACKGROUND: **Non-invasive tool of community diagnosis for onchocercal endemicity needs to be identified and ascertained for their utility and effectivity in order to facilitate the control of onchocerciacis in sub-Saharan Africa**

OBJECTIVE: **To determine the utility and effectiveness of the Wu-Jones Motion Sensitivity Screening Test (MSST) in detecting optic nerve diseases in onchocercal-endemic rural Africa.**

METHODS: **MSST was applied to sampled subjects in the selected communities of Raja in Sudan; Bushenyi in Uganda; Morogoro in Tanzania; and of Ikom, Olamaboro and Gashaka in Nigeria. Basically, six points within the central field of vision were repeatedly tested at 1/3 meter from the screen of a laptop computer in a room darkened. Motion sensitivity was expressed as a percentage of motion detected in the individual eye and this was averaged for the community.**

RESULTS: **A total of 3,858 eyes of 2,072 patients were examined. Seventy-six percent of the subjects completed the test, at an average test time of 120.4 (66.7) seconds. The overall mean motion sensitivity of all eyes tested was 88.49 (17.49%). At a cut-off point of 50%, 6.4% of all subjects tested were subnormal, while at 70% cutoff, 13.3% were subnormal. The highest proportion of 50% cutoff sub-normality was recorded at Morogoro at 12.7%.**

CONCLUSION: **Motion Sensitivity Screening Test was widely accepted and easily administered to the rural and largely illiterate subjects studied. Our data suggest that the proportion of severe field defects by MSST in a community, with cutoff at 33%, best correlates with optic nerve disease prevalence, while proportion of defect from a higher cut-off level at about 50%, best correlates with overall ocular morbidity. WAJM 2010; 29(6): 412–416.**

Keywords: **Computerized motion sensitivity screening test, optic nerve disease, onchocerciasis.**

RÉSUMÉ

CONTEXTE: *L'utilité et l'efficacité des méthodes non invasives de diagnostic communautaire de l'endémie de l'onchocercose doivent être identifiées et certifiées afin de faciliter le contrôle de cette maladie en Afrique subsaharienne.*

OBJECTIF: *Déterminer l'utilité et l'efficacité du Test de dépistage de la Sensibilité du Mouvement de Wu-Jones (MSST) dans la détection de maladies du nerf optique lié à l'endémie de l'onchocercose en Afrique rurale.*

METHODES: *Le Test de dépistage de Sensibilité du Mouvement de Wu-Jones a été appliqué sur des échantillons de sujets choisis dans les communautés de Raja au Soudan; Bushenyi en Ouganda; Morogoro en Tanzanie; et d'Ikom, Olamaboro et Gashaka au Nigeria. Essentiellement, six points dans le champ visuel central étaient à plusieurs reprises évalués à 33 centimètre de l'écran d'un ordinateur portable dans une pièce obscure. La sensibilité de mouvement a été exprimée en pourcentage de mouvement détecté dans l'œil individuel et une moyenne pour la communauté a été déterminée.*

RESULTATS: *Un total de 3858 yeux de 2072 patients a été examiné. Soixante-seize pour cent des sujets a eu un test complet, avec un temps moyen de test de 120.4 (66.7) secondes. La sensibilité de mouvement moyenne complète de tous les yeux évalués était 88.49 (17.49 %). Sur un seuil de 50 %, 6.4 % de tous les sujets évalués étaient subnormaux, tandis qu'à un seuil de 70 %, 13.3 % étaient subnormaux. La proportion la plus haute de sub-normalité de seuil de 50 % a été enregistrée à Morogoro dans la Tanzanie à 12.7 %.*

CONCLUSION : *le test de dépistage de sensibilité du mouvement est largement accepté et réalisé facilement chez les sujets ruraux et qui en grande partie sont illettrés. Nos données suggèrent que la proportion d'altération sévère du champ visuel par MSST dans une communauté, avec un seuil à 33 %, est mieux corrélée avec la prévalence de l'atteinte du nerf optique, tandis que celle avec un seuil plus élevé à 50 %, est mieux corrélée avec la morbidité oculaire complète.* ***WAJM 2010; 29 (6): 412–416.***

Mots-clés: *test de dépistage de sensibilité de mouvement informatisé, maladie de nerf optique, onchocercose*

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Abbreviations: OND, Optic Nerve Disease; **MSST,** Motion Sensitivity Screening Test.

INTRODUCTION

Optic Nerve Disease (OND) is a major pathway to blindness in onchocerciasis particularly in the Savannah-Forest mosaic.[1] The Quantification of OND however can be problematic in rural settings. The semi-automated Friedman visual field analyzer had been used by the Abiose group in Kaduna in the late eighties[1], but was not computerized and was rather bulky. The portable laptop-based computerized Motion Sensitivity Screening Test (MSST), which is also known as the Wu-Jones test, was then introduced for research in onchocerciasis-endemic communities[2,3] and in Western countries.[4] Also, its usefulness in glaucoma screening in clinical practice in Nigeria has been reported.[5] In these studies, its reliability and reproducibility were demonstrated. Subsequently in the mid nineties, the African programme for Onchocerciasis Control commissioned multi-disciplinary studies in 14 sites of nine countries with endemic onchocerciasis to assess the impact of Community Directed Treatment with Ivermectin (CDTI) on onchocerciasis. The objective of the ophthalmic aspect of the study was to establish baseline ophthalmologic parameters with a view to comparing them over time following CDTI and the MSST was applied in these communities as part of the assessment. The hypothesis that would be eventually tested is that CDTI will prevent or delay progression of onchocercal eye lesions and blindness, including visual field defects[6]. In this communication, we seek to assess the usefulness of the MSST in community diagnosis. To what extent does the Wu-Jones test, applied in cross section, reflect the burden of optic nerve disease in particular and the overall burden of eye disease within rural communities? Can it be relied upon to follow up and assess the impact of CDTI in subsequent years? This communication reports on the findings in six Anglophone sites.

SUBJECTS, MATERIALS, AND METHODS

Study Sites

The computerized Motion Sensitivity Screening Test (MSST) as described by Wu *et al*[2,4] in 1992 was applied in six rural African communities in 1999. The communities included three in Nigeria: Ikom (Etikpe, Nkarasi 11 and Nkonfap villages) in Cross River State, Sardauna and Gashaka (Lemme Furwa, Lainga, Karamti and Jamtari villages) in Taraba State, and Olamaboro (Ogbodo, Ubalu, Inelle and Unyi Erogu villages) in Kogi State. The other three communities were Raja (Hai mater, Hai Manga, Wau Jadid, Hai Nasir and Mayonga villages) in Sudan, Bushenyi in Uganda and Morogoro in Tanzania.

Community Selection and Sampling Method

The study sites had been carefully selected by the African Programme for Onchocerciasis Control (APOC) which commissioned the study using the following criteria: uniformity in onchocercal endemicity (meso- or hyper), adequacy of social and cultural stability, nil ivermectin treatment or ivermectin treatment coverage below 25%, accessibility and the availability of Rapid Epidemiological Mapping of Onchocerciasis (REMO) and Rapid Epidemiological Assessment (REA) data.[7]

In each site, a computer generated sample of 1,500 was randomly selected from a sampling frame of randomly selected households in these communities. All individuals aged 10 years and above were selected from this list for detailed eye examination including MSST.

Wu Jones MSST

This test has been described in details elsewhere.[2,4] Briefly, six points within the central field of vision were repeatedly tested at 1/3 meter from the screen of a laptop computer in a room darkened either with black curtains or windows shut to cut out daylight. A tiny source of light was allowed into the room to enable the respondents and the computer operator observe the computer screen and for the latter record the results, and the subject to move safely in the room. After being comfortably seated in front of the computer, the test was explained to the subject in the local language. The subject was then positioned on the chin-pad in front of the computer. At the computer's prompting, the operator selected the eye to be tested first, usually the right eye. A series of vertical, oscillating illuminated white targets appeared on the screen arranged in a 6 by 8 array. Six of these points which coincide with critical points in the central field of vision were tested by oscillatory movement of the corresponding bars. Each point was tested six times. The patient pressed the space bar on the computer or clicked on a mouse when motion was detected. This response was recorded automatically in the computer system. Detection of motion only between 0–2 times out of six was categorized as a severe defect, 3–4 as a moderate defect and 5–6 as normal. These scores were then aggregated for each eye to give an overall impression of the visual field. A score of 12 or less was therefore taken as a severe field defect, 13–24 as moderate and scores above 24 as normal. In addition, motion sensitivity was computed as a percentage of the maximum score of 36. Local nurses or assistants were trained to administer the test to the largely illiterate communities studied. A record of the findings was entered on each subject's record form as a backup and analysis was carried out using SPSS 12.0 software package. Pearson correlation coefficient (r) was used to determine the association between variables. $P<0.05$ was considered statistically significant.

RESULTS

For the six sites under review, the computerized Motion Sensitivity Screening Test (MSST) was applied to a grand total of 3,858 eyes comprising 2,072 right eyes and 1,786 left eyes in 2,072 subjects. Mean reliability of the test was 69.8% with a standard deviation (SD) of 34.6. The time taken for the test varied from 36 seconds to 1,158 seconds with a mean of 120.4 seconds, SD 66.7. The test was generally acceptable to the subjects and it was possible to complete it for the 2,072 subjects despite the fact that they were largely illiterate. The test could not be performed or could not be completed in 606 (24%) of all the 2,678 who were initially listed to undergo the MSST test. The overall mean motion sensitivity for all eyes tested was 88.49% (17.49%). Of the total number of eyes tested, 3375 (87.5%) were normal, 405 (10.5%) had moderate field loss while 78(2.0%) had severe loss. If however a cut off point of 50% is applied, 6.4% were sub-normal, while if the cutoff point were taken as 70%, 13.3% would be subnormal. These cut off points are demonstrated in Figure 1, which shows the cumulative frequencies of MSST scores in all eyes

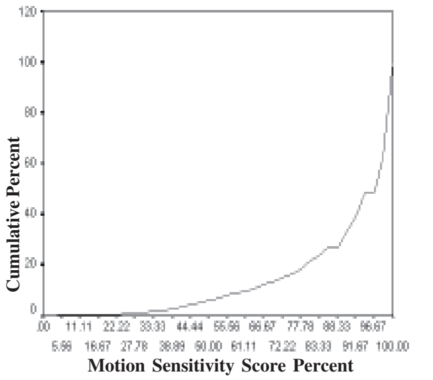

Fig. 1: Composite Motion Sensitivity Screening Test Scores in 3858 Eyes of Residents of Sixs Onchoendemic Communities

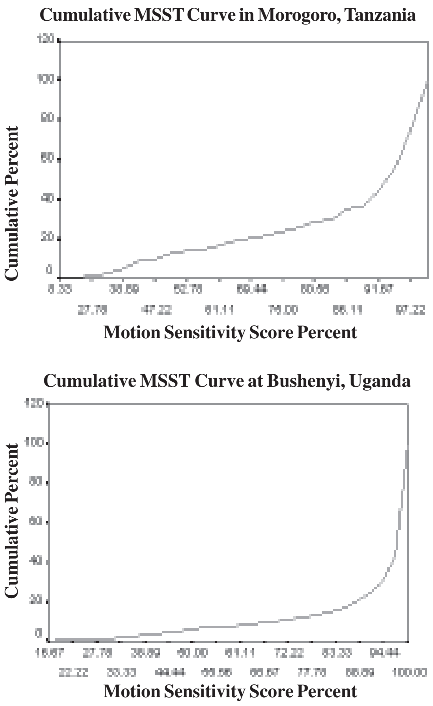

Fig. 2: Comparative cumulative motion sensitivity screening (MSST) scores in Morogoro (Top) and Bushenyi (Bottom). Note the relative 'shift' to the right of the curve for Bushenyi, which is indicative of a lower rate of subnormal MSST in the Bushenyi population, and a reflection of the lower overall prevalence of ocular morbidity.

tested. There was a weak but statistically significant negative correlation between MSST scores and age (Pearson's correlation coefficient = –0.30, P<0.01).

Results by Site

Table 1 shows by site the prevalence of normal, moderate and severe field loss in the various sites as well as the mean MSST score per site. The highest mean MSST score was recorded in Raja at 91.9% and the lowest in Kogi at 83.4%. The table also shows the proportion of subnormal MSST scores per site at the 50% cut off point. The highest proportion was recorded at Morogoro at 12.7% while the lowest was recorded at Ikom, Cross River state at 3.9%.

Correlation with Ocular Pathology

The site prevalence rates of certain selected ocular pathology indicators are shown in Table 2. The strongest correlations were observed between the proportion of severe field loss and the prevalence of optic atrophy yet were not statistically significant (r=0.54, P=0.27). Subnormal MSST scores at the 50% cutoff level correlated best with the combined prevalence of blindness and visual impairment at (r=0.66, P=0.155). These tendencies may be well illustrated by two extreme examples of Morogoro and Bushenyi. Whereas Morogoro recorded the highest level of blindness and visual impairment at 30%, there was a relatively low prevalence of optic atrophy, at 4.8%, because most of the visual problems were attributable to uveitis and secondary cataracts. Consequently, the proportion of severe field loss, which reflects the prevalence of optic atrophy, was also low at 1.8%, but the proportion of subnormal MSST, which reflects the overall blindness and visual impairment status, was the highest in the series at 12.7. On the contrary, Bushenyi had a low burden of blindness and visual impairment at 5.8% but a relatively high prevalence of optic atrophy at 12.4%. This reflects in a relatively higher prevalence of severe field loss at 2.1% but a lower prevalence of subnormal MSST at 6.3%. The cumulative MSST curves for Bushenyi and Morogoro are shown in Figure 2. The cumulative curve for Morogoro is closer to what is expected in an endemic onchocercal community with a relative 'shift' of the curve to the left, while that of Bushenyi approximates the situation in a non-endemic situation.

DISCUSSION

Wu *et al*[2,4] had postulated that the MSST could be useful in mass screening or epidemiological study of diseases which commonly produce field loss with preserved macular function, such as onchocerciasis and glaucoma. This is possibly the first time since that publication that MSST has been used on such a large scale, apart from a study carried out by Umeh et al in 1997 on 100 subjects in South Eastern Nigeria.[3] Twenty-four percent of the respondents were unable to complete the test for various reasons, which included inadequate vision less than finger counting (CF) and subsequent poor fixation on the central target. This appears to have been a particular problem in Raja, where the prevalence of poor vision was high. Otherwise, acceptability of the test was high as found by Quigley *et al.*[8] Field trials in rural settings using the Friedman semi-automated perimetry had been carried out in Nigeria by Abiose et al[1] and later Murdoch *et al.*[9] These had demonstrated that it was possible to obtain reliable and reproducible perimetric data in rural communities. Our observation was that most subjects were able to understand the test once it was explained to them in their own local dialect. The completion time for the test, which does not include the time for explanation, averaged about two minutes. In the field, a lot of time was saved if the explanation was done to a group, and natives who had successfully carried out the test were recruited to explain the procedure to their compatriots. Furthermore, mean reliability was almost 70% which can be considered good for the largely semi-literate and illiterate populations studied. Using a cut-off point of 50% or less, 6.4% of the combined population was found to have subnormal MSST scores. This subnormal rate varied from 3.9% in Ikom to 12.7% in Morogoro. Wu *et al*[2] had found that 15% of the oncho-endemic population in

Table 1: Outcome of Wu-Jones Motion Sensitivity Screening Test (MSST) in various Oncho-endemic Sites

	Number (%) Field Loss				MSST Scores (%)	
Site	Eyes (N)	Moderate	Severe	Any	(≤ 50%)	Mean
Raja (Sudan)	719	31 (4.3)	20 (2.8)	51 (7.1)	4.5	91.9
Kogi (Nigeria)	551	111 (20.1)	14 (2.5)	125 (22.6)	10.5	83.4
Taraba (Nigeria)	850	112 (13.2)	18 (2.1)	130 (15.3)	6.6	86.1
Ikom (Nigeria)	894	71 (7.9)	9 (1.0)	80 (8.9)	3.9	89.4
Bushenyi (Uganda)	679	51 (7.5)	14 (2.1)	65 (9.6)	6.3	91.8
Morogoro (Tanzania)	165	29 (17.6)	3 (1.8)	32 (19.4)	12.7	84.7

Table 2: Prevalence of Selected Ocular Pathologies in the Oncho-endemic Sites

	Prevalence Rates (%)								
Site	Optic	Glaucoma	Optic Atrophy + Glaucoma	Chorio-retinitis	Sclerosing keratitis	Cataract	Blindness Prevalence	Visual Impairment	Blindness + Visual Impairment
Raja (Sudan)	21.5	13.8	35.3	16.7	12.2	13.1	10.3	7.9	18.2
Kogi (Nigeria)	5.3	2.3	7.6	4.3	0.0	9.8	3.3	13.3	16.6
Taraba (Nigeria)	7.3	5.2	12.5	3.1	6.5	9.1	3.2	6.3	9.5
Ikom (Nigeria)	7.3	12.4	19.7	35.8	6.3	7.5	2.8	10.3	13.1
Bushenyi (Uganda)	12.4	1.4	13.8	3.3	3.8	6.3	1.9	3.9	5.8
Morogoro	4.8	4.2	9.0	2.6	4.6	27.4	15.3	12.7	30.0

Nigeria had subnormal motion sensitivity loss while only 5% was found in non-endemic Nigerian population. Furthermore, a 70% cut-off point gives a subnormal rate of 13.3% compared to 25% in the Kaduna-Nigerian onchocerciasis population quoted by Wu *et al.*[2, 4] This may suggest that the overall burden of optic nerve disease (and other factors that may contribute to Motion Sensitivity reduction) in the endemic sites considered in this article is less than in the particular sites considered in the study by Wu *et al.*[2,4] Inter-observer variations may, also be a factor although this was not a major issue according to Wu *et al,*[2,4] as the running of the test requires little interference from the observer. However, it is difficult to standardize the ambient environment especially with regard to background lighting. A background luminance of 200 lux has been suggested, and perhaps ways of standardizing this in the field should be sought if it is found that this may significantly affect the outcome of the test. This will make for easier comparison across sites. However the presence of 'any' field loss in our population ranged from 7.1% in Raja to 19.2% in Morogoro. We found a weak but statistically significant negative correlation between MSST scores and age (–0.30, p<0.01). This is greater than the –0.21 (p<0.01) found by Wu *et al*[2] in endemic Nigerian populations.

There was a wide variation in MSST scores across the sites, as indicated in the results. It would be tempting to conclude that this was mainly due to variations in the prevalence of optic nerve disease. Due to the small sample number of sites considered in this communication, it is difficult to draw conclusions on the correlation between overall community MSST performance and the prevalence of optic nerve disease. However, as stated above, the strongest correlation (0.54 Pearson's) was observed between the prevalence of optic atrophy and severe field loss, which in our context is a field ≤ 33% of normal. However, subnormal MSST at 50% cut-off point correlated best with combined prevalence of blindness and visual impairment at 0.66. These tendencies are illustrated by the findings in Morogoro, which has a high prevalence of blindness and visual impairment (30%) mostly from non optic nerve disease (OND) causes, and Bushenyi, which has an overall low prevalence of blindness, and visual impairment but a relatively higher prevalence of optic nerve disease. These results tend to suggest that when applied in a cross sectional manner, the proportion of severe field defects in a community is a more reliable predictor of the prevalence of OND, while the 50% cutoff point is more indicative of overall ocular disease burden. Hopefully, when results from more sites become available, it should be possible to make more definitive statements. What is certain however is that comparisons in time within communities should be a fairly straightforward and reliable way in which ocular disease burden can be assessed. Wu *et al*[2,4] had commented upon typical patterns in the cumulative frequency curves. A 'shift' to the right of the cumulative frequency curve is indicative of a tendency to normality. It will be interesting to see what the cumulative curves wouldappear like after five years of Community Directed Treatment with Ivermectin.

In conclusion, the Wu-Jones MSST has been applied as a cross sectional instrument in six Anglophone onchocercal-endemic communities. A wide range in overall community scores was noticed, probably reflective of disease diversity within the various communities studied. It is intended that the tests will be repeated in the next five years following Ivermectin treatment, when the influence, if any, on community wide MSST performance will become more apparent.

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