Asian Journal of Research and Reports in Neurology

2(1): 37-45, 2019; Article no.AJORRIN.51408

Validity of the Filipino Version of the Michigan Neuropathy Screening Instrument as a Measure of Distal Symmetric Peripheral Neuropathy among Diabetic Patients in the Clinic

Ma. Luisa Gwenn Pabellano-Tiongson[1*], Glennis Fiona J. Javelosa[2] and Armand Delo A. Tan[2]

[1]Department of Neurosciences, University of the East Ramon Magsaysay Memorial Medical Center, Philippines.
[2]Department of Internal Medicine, University of the East Ramon Magsaysay Memorial Medical Center, Philippines.

Authors' contributions

This work was carried out in collaboration among all authors. Authors MLGPT and GFJJ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors GFJJ and ADAT managed the analyses of the study. All authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Mohammad Abu-Hegazy, Professor, Department of Neurology, Faculty of Medicine, Mansoura University, Egypt.
Reviewers:
(1) Elias Aguirre, Universidad Católica Los Ángeles de Chimbote, Perú.
(2) Vinotha Sanmugarajah, University of Jaffna, Sri Lanka.
Complete Peer review History: https://sdiarticle4.com/review-history/51408

Original Research Article

Received 22 June 2019
Accepted 11 September 2019
Published 19 September 2019

ABSTRACT

Aims: To determine the accuracy of the Filipino version of the Michigan Neuropathy Screening Instrument (MNSI) in detecting distal symmetric peripheral neuropathy (DSPN) among diabetic patients, by comparing it to electromyography-nerve conduction velocity (EMG-NCV) as a gold standard.
Study Design: Cross-sectional study.
Place and Duration of the Study: Out-patient Department, University of the East Ramon Magsaysay Memorial Medical Center Inc., Philippines; From May 2016 to March 2017.

**Corresponding author: E-mail: gpabellano@gmail.com;*

Methodology: Researchers tested 103 patients with Type 2 diabetes mellitus in the out-patient clinic of a single-centre tertiary hospital and determined the sensitivity and specificity of the Filipino version of the MNSI in identifying DSPN by comparing it to the EMG-NCV as a gold standard. Risk factors for neuropathy were also identified.
Results: The sensitivity of the combined Filipino MNSI questionnaire and clinical examination tool was 74.7%, and a specificity of 25%. The MNSI questionnaire scores had a statistically significant correlation to the degree of neuropathy as measured by the EMG-NCV (*P*= .01). There was no statistically significant difference between those with and without DSPN in terms of BMI, history of smoking, duration of diabetes, level of glycaemic control or presence of hypertension.
Conclusion: The Filipino MNSI may be used as a screening tool for distal symmetric peripheral neuropathy among diabetic patients due to its high sensitivity (74.7%). A positive Filipino MNSI will signal the need for further investigation using the EMG-NCV. The MNSI can be performed easily by a healthcare worker in the clinic to screen diabetic patients for neuropathy, and to monitor disease severity, preventing its complications.

Keywords: Diabetes mellitus; peripheral neuropathy; screening; diabetic neuropathy.

1. INTRODUCTION

In the Philippines, 12% of adult Filipinos are diagnosed to have diabetes or pre-diabetes [1]. Peripheral neuropathy is seen in 50% of diabetic patients [2]. The presence of peripheral neuropathy was found to be a primary risk factor for a major limb amputation. In 2006, 1 out of 2 Filipino patients with diabetic foot ulcer had a major limb amputation [3]. Risk identification is crucial in the prevention of diabetic foot complications such as foot ulcers and major limb amputations. However, 50% of patients with chronic diabetic peripheral neuropathy have no symptoms consistent with neuropathy [4].

Peripheral neuropathy among diabetic patients should be diagnosed based on a minimum of two abnormal signs and/or symptoms [5]. The gold standard for diagnosis of peripheral neuropathy is a nerve biopsy. However, due to the invasiveness of nerve biopsy, the electromyography-nerve conduction velocity (EMG-NCV) study is used as an alternative to the gold standard. The EMG-NCV is a time-consuming and expensive procedure for low-income patients in a developing country.

The Michigan Neuropathy Screening Instrument (MNSI) is a rapid, reproducible and reliable ambulatory screening test [6], which combines more than one test for peripheral neuropathy. The MNSI is composed of 2 parts: the first part is a self-administered questionnaire regarding the symptoms of peripheral neuropathy; the second part is a clinical examination of the lower extremities eliciting the signs of peripheral neuropathy.

At present, there is no screening instrument used in the clinics to aid in the diagnosis of peripheral neuropathy among Filipino diabetic patients for early prevention of its complications. A local study by Lobaton (unpublished observation) was done to translate the MNSI questionnaire from English to Filipino. The Filipino version of the MNSI questionnaire has been found to have good construct validity, however its sensitivity and specificity compared to EMG-NCV has not yet been studied.

The goal of this study is to determine the accuracy of the Filipino version of the MNSI in detecting distal symmetric peripheral neuropathy (DSPN) among diabetic patients, by comparing it to EMG-NCV as a gold standard.

2. METHODOLOGY

2.1 Research Design and Population

This was a cross-sectional study on 103 adult participants known to have Type 2 Diabetes Mellitus (T2DM), diagnosed according to the local guidelines [7], seen in the University of the East Ramon Magsaysay Memorial Medical Center Out-patient Department from May 2016 to March 2017. The participants may or may not have symptoms of neuropathy. Excluded from the study were patients unable to read or write on their own in Filipino. Non-appearance on the scheduled date for EMG-NCV study was considered as voluntary withdrawal by the participant.

2.2 MNSI and Laboratory Examinations

The self-administered Filipino version of the MNSI questionnaire (Appendix A) and the clinical

examination were done on the same day. The questions aimed to identify peripheral neuropathy symptoms such as numbness of extremities, painful or pricking sensations, and difficulty in ambulation. A "yes" answer to questions 1-3, 5-6, 8-12, 14-15 was equivalent to one point. A "no" answer for questions 7 and 13 was equivalent to one point. All 15 questions were included in the scoring algorithm [8].

After the questionnaire, the participant was evaluated using the MNSI clinical examination tool which include foot inspection, achilles reflexes examination, determination of the vibratory perception threshold, and the monofilament test. The MNSI clinical examination was performed by one investigator to minimize rater variability (Appendix B). The investigator was blinded from the results of the MNSI questionnaire prior to the examination. The score of ≥4 on the questionnaire or the score of ≥2.5 on the clinical examination was used to indicate the presence of peripheral neuropathy [8].

In addition to the clinical examination, the HbA1c level of the participant was taken to determine the level of glucose control of the participant. Haemoglobin levels were also identified to assure that the level of the glycosylated haemoglobin was not altered due to the presence of anaemia.

2.3 Electromyography-Nerve Conduction Velocity Study

EMG-NCV was performed on all the study participants, within 1 week of completion of the MNSI. Nerve conduction studies (NCS) were performed using the Nicolet Viasys Viking Select EMG EP System. NCS reference values used were age and height adjusted. Prior to the study, temperature was measured to ensure a surface hand temperature of ≥32.0°C and ≥31.0°C for the feet. Bilateral median, sural, tibial and peroneal NCS were performed using surface stimulating and recording techniques based on the recommendation of the American Association of Neuromuscular and Electro-diagnostic Medicine. Latencies, amplitudes, and conduction velocities were automatically measured by the system. Peroneal and tibial nerve motor amplitudes were measured as baseline to negative peak for the compound muscle action potential (CMAP) and as baseline to negative peak for the sural sensory nerve action potential amplitude, or from the positive peak (if present) to the negative peak. The sural nerve latency was measured at the onset of the initial deflection from baseline. The F-wave latency was determined after 10 supra-maximal stimuli were applied [9].

The results of the EMG-NCV were interpreted by a single board-certified neurologist and electromyographer. Presence of DSPN was diagnosed with an abnormal median, sural (DSL and/or SNAP) and abnormal peroneal (CMAP and/or F-wave) response [10]. Severity of peripheral neuropathy by nerve conduction study was based on the severity criteria of Baba's diabetic severity classification [11]:

1. **Mildly abnormal:** Reduced sensory conduction velocity, motor conduction velocity and prolongation of F wave latency;
2. **Moderately abnormal:** Reduced sural SNAP amplitude of less than 5 mV;
3. **Severely abnormal:** Reduced peroneal/tibial CMAP amplitude of less than 2 mV.

2.4 Data Processing

Data was analyzed using Stata v13 software and Epiinfo6 software. To determine the utility of the Filipino version of the MNSI in screening DSPN among type 2 diabetic patients, measures of validity (sensitivity, specificity, positive and negative predictive values and positive and negative likelihood ratios) were computed. Differences in risk factors between those with DSPN and those without DSPN, as diagnosed by EMG-NCV, were determined using independent t-test for quantitative variables (age, duration of diabetes, HbA1c) and chi-square test for qualitative variables (smoking history and presence of hypertension). A p-value <0.05 was used as cut-off for significance.

3. RESULTS

A total of 103 type 2 diabetic patients participated in the study. Majority were females with a mean age of 62 ± 11 years, the youngest being 31 years old and the oldest being 84 years old (Table 1). The average duration of diabetes among all participants was 12 ± 8.6 years. Half of the patients have had diabetes for more than 10 years. Six patients were recently diagnosed with diabetes (less than a year prior to enrolment),

Table 1. Demographic, clinical and laboratory profile of 103 patients

Patient's characteristics	Value
Demographic characteristics	
Age in years	62.1 ± 10.5
Gender	
Male	22 (21.4%)
Female	81 (78.6%)
Clinical characteristics	
BMI (Mean = 25 ± 3.9)	
Underweight (<18.5)	2 (2.0%)
Normal (18.5-<23)	38 (37.2%)
Overweight (23-<27)	37 (36.3%)
Obese (≥27)	25 (24.5%)
Smoking history	27 (26.2%)
Hypertension	69 (67.0%)
Duration of Diabetes (Mean = 12 ± 8.6 years)	
< 1 year	6 (5.9%)
1-9 years	45 (44.1%)
≥ 10 years	51 (50.0%)
Laboratory (n=89)	**Mean, SD**
Glycosylated haemoglobin (HbA1c)	8.0 ± 2.2
Haemoglobin mg/dL	133.8 ± 12.2

and half of them were symptomatic and had neuropathy on EMG-NCV. Mean BMI was 25 ± 3.9 kg/m^2. Most patients were either overweight (37%) or obese (25%). Only 38% had normal BMI. Smoking history was observed in 26% of cases and hypertension was present in 67% of patients. The average HbA1c of those who had a laboratory determination was 8.0% ± 2.2%. The rest of the hematologic parameters were within normal limits.

There were no significant differences in mean age, body mass index, smoking history, presence of hypertension, duration of diabetes and HbA1c levels between those with and without DSPN by EMG-NCV (Table 2).

The mean MNSI questionnaire score was 6.1 ± 2.1 and the mean clinical examination score was 4.5 ± 2.0. Sixty-five participants were symptomatic as evidenced by an MNSI questionnaire score of ≥4.0, and 47 participants had positive clinical examination scores (≥2.5). Seventy-nine participants (76.7%) were found to have DSPN via EMG-NCV. A majority (72.4%) of patients had mild neuropathy, while 22.8% had moderate neuropathy, and only 7.6% had severe neuropathy.

The combined MNSI (questionnaire and clinical examination) identified 77 participants to have DSPN. Among those positive on combined MNSI, 76.6% truly have DSPN, and among those negative on combined MNSI 23.1% do not have DSPN on EMG-NCV (Table 3). The computed sensitivity of the combined MNSI was 74.7%, and the specificity was 25%. The computed sensitivity of the Filipino MNSI questionnaire was

Table 2. Comparison of risk factors among those with and without DSPN by EMG-NCV

Risk factors	EMG-NCV		p-value
	With DSPN	Without DSPN	
Gender			0.23
Male	19 (24.1%)	3 (12.5%)	
Female	60 (76.0%)	21 (87.5%)	
Age in years	62.4 ± 10.1	61.2 ± 12.0	0.61
BMI	24.8 ± 4.2	24.5 ± 2.9	0.76
Smoking history	22 (27.9%)	5 (20.8%)	0.49
Presence of hypertension	53 (67.1%)	16 (66.7%)	0.97
Duration of DM in years	11.0 (8.3%)	10.9 (9.9%)	0.96
HbA1c	8.1 ± 2.2	7.7 ± 2.2	0.48

Table 3. Results of the Filipino MNSI and EMG-NCV

Combined Filipino MNSI	EMG-NCV		Total
	Positive for DSPN n=79	Negative for DSPN n=24	
Positive for DSPN	59	18	77
Negative for DSPN	20	6	26

64.6%, with a specificity of 33.3%. The MNSI clinical examination yielded a sensitivity of 48.1% and a specificity of 62.5%. There is a positive, direct, significant (*P*=0.01) but low correlation (correlation coefficient = 0.26) between scores on MNSI questionnaire and degree of neuropathy.

4. DISCUSSION

The prevalence of peripheral neuropathy among diabetic patients can reach up to 50% [2]. In a study done in 2013, 49 out of 106 diabetic patients (46.2%) had diabetic polyneuropathy [12]. According to the Philippine practice guidelines for diabetes, up to 25% of newly diagnosed patients may have micro-vascular complications such as neuropathy [7]. These findings were reflected in this study as it diagnosed neuropathy among 76.7% of the study participants. Half of the newly diagnosed diabetic patients had neuropathy on EMG-NCV. This may be attributed to the study site being a tertiary hospital which usually receives patients with more advanced or long-standing illnesses, as evidenced by the mean diabetes duration of 12 years.

Alarmingly, 60.8% of the study participants were either overweight or obese. The mean BMI of 25 kg/m^2 seen in this study is similar to the mean BMI seen in other studies on diabetic patients: 25 kg/m^2 [13] and 28.2 kg/m^2 [8]. Awareness of the magnitude of the problem of obesity among diabetic patients is vital in the prevention of diabetic complications. This high prevalence of overweight and obese patients among study participants indicate the need to further strengthen the campaign for proper nutrition and regular exercise, even in tertiary hospitals.

As seen in other studies [10,12], the classic risk factors for diabetic neuropathy (BMI, smoking history, presence of hypertension, duration of diabetes and HbA1c level) were not significantly different between those with DSPN and those without DSPN.

4.1 MNSI and EMG-NCV

The sensitivity of the combined MNSI was 74.7%, and a specificity of 25%. These values are comparable to the sensitivity and specificity of the original MNSI (sensitivity 40-61%, specificity 79-92%) [8], although a head-to-head comparison was not the goal of this study. The all-important task of screening diabetic patients for neuropathy may be accomplished in the primary care setting by administering the self-administered Filipino MNSI questionnaire and by training primary healthcare providers in the use of the MNSI clinical examination tool. Availability of a simple and non-invasive screening tool in the primary healthcare setting may increase detection of neuropathy among diabetics and facilitate timely intervention. Early identification of DSPN can decrease the socioeconomic losses associated with this disease.

And because the Filipino MNSI questionnaire scores had a statistically significant correlation to the degree of neuropathy as measured by the EMG-NCV, the questionnaire may also be used in monitoring the progression of diabetic neuropathy in the clinic. This is an important tool especially for low- to middle-income countries like the Philippines.

It must, however, be stressed that the MNSI aims to prompt the clinician to pursue further investigation of distal symmetric neuropathy [12, 14]. The American Diabetes Association still recommends a thorough neurologic examination and the use of EMG-NCV for the diagnosis of diabetic neuropathy [15]. Diabetic peripheral neuropathy can be diagnosed after other causes of neuropathy are excluded (e.g. neurotoxic medications, heavy metal poisoning, alcohol abuse, vitamin B12 deficiency, renal disease, chronic inflammatory demyelinating neuropathy, inherited neuropathies and vasculitis) [15].

Among the 79 patients diagnosed to have neuropathy by EMG-NCV, 25.3% had normal MNSI results. This should be a cause of concern as 1 out of 4 enrolled diabetic patients with existing peripheral neuropathy did not manifest signs and symptoms of neuropathy which can lead to an increased risk for complications due to delayed intervention. These asymptomatic patients should be followed up as they have increased risk of complications based on the presence of neuropathy [12].

The Rochester Diabetic Neuropathy Study found 10% of peripheral neuropathy in diabetic patients was of nondiabetic causation [16]. In this study, 24% of symptomatic patients had no diabetic neuropathy on EMG-NCV. However, ruling out other causes of distal symmetric peripheral neuropathy among study participants was not within the scope of this study.

5. LIMITATIONS AND RECOMMENDATIONS

The study limitations include: confined number of study participants, other causes of DSPN were not ruled out, and incomplete laboratory results of some participants.

Future longitudinal studies involving a large sample size may help further define the role of the Filipino MNSI in monitoring the progression of diabetic neuropathy in the clinic. Also, the authors recommend the use of the Filipino MNSI in the primary healthcare setting to aid in the identification of diabetic patients who are at risk for complications.

6. CONCLUSION

The Filipino MNSI may be used as a screening tool for distal symmetric peripheral neuropathy among diabetic patients due to its high sensitivity (74.7%). A positive Filipino MNSI will signal the need for further investigation using the EMG-NCV. The MNSI can be performed easily by a physician or healthcare worker in the clinic for screening diabetic patients for neuropathy, and in monitoring disease severity, to prevent its complications.

CONSENT

A written informed consent was obtained from all study participants before any study-related procedure was done.

ETHICAL APPROVAL

The study complied with the declaration of Helsinki and was approved by the local research ethics committee.

ACKNOWLEDGEMENTS

Funding for the study came from the research grant from the Philippine Council for Health Research and Development. The study sponsor had no involvement in the study design, collection, analysis and interpretation of data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nam HC, Whitind D, Guariguata L, et al. International diabetes federation atlas 6th ed. 2013;122-123.
(Accessed 31 May 2015)
Available:www.idf.org/diabetesatlas
2. Deli G, Bosnyak E, Pusch G, Komoly S, Feher G. Diabetic neuropathies: Diagnosis and management. Neuroendocrinology. 2013;98:267-80.
3. Cardino MJ, Josol C, Isip-Tan I, Jimeno C. Risk factors for major amputation of diabetic foot ulcers. Phil J of Int Med. 2011; 49(2):75-78.
4. Boulton A. Management of diabetic peripheral neuropathy. Clin Diab. 2005; 23(1):9-15.
5. Boulton A, Vinik A, Arezzo J, et al. Diabetic neuropathies: A statement by the American Diabetes Association. Diab Care. 2005;28(4):956-62.
6. Lunetta M, Le Moli R, Grasso G, Sangiorgio L. A simplified diagnostic test for ambulatory screening of peripheral diabetic neuropathy. Diab Res and Clin Prac. 1998;39:165-72.
7. Jimeno C, Abad L, Andag-Silva A, et al. UNITE for diabetes Philippines. Philippine practice guidelines on the Diagnosis and Management of Diabetes Mellitus. Compendium of Philippine Medicine; 2014.
(Accessed 17 March 2015)
Available:http://obesity.org.ph/v4/wp-content/uploads/2014/07/Diabetes-United-for-Diabetes-Phil.pdf
8. Herman WH, Pop-Busui R, Braffett BH, et al. Use of the michigan neuropathy screening instrument as a measure of distal symmetrical peripheral neuropathy in type 1 diabetes: Results from the diabetes control and complications trial/ epidemiology of diabetes interventions and complications. Diabet Med. 2012;29(7): 937-44.
9. Dunnigan SK, et al. Conduction slowing in diabetic sensorimotor polyneuropathy. Diabetes Care. 2013;36(11):3684-90.
10. Kong X, Lesser E, Potts F, Gozani S. Utilization of nerve conduction studies for

the diagnosis of polyneuropathy in patients with diabetes: A retrospective analysis of a large patient series. J Diabetes Sci Technol. 2008;2(1):268-74.

11. Baba M, Suzuki C, Tomiyama M. Five-year prospective study on development of diabetic foot with a severity staging system of diabetic neuropathy by nerve conduction study. Journal of the Neurological Sciences; 2017.
Available:https://doi.org/10.1016/j.jns.2017.08.768.
12. Mete T, Aydin Y, Saka M, et al. Comparison of efficiencies of michigan neuropathy screening instrument, neurothesiometer, and electromyography for diagnosis of diabetic neuropathy. Int J of Endocrinology; 2013.
(Accessed 11 July 2016)
Available:http://dx.doi.org/10.1155/2013/821745.
13. Al-Geffari M. Comparison of different screening tests for diagnosis of diabetic peripheral neuropathy in Primary Health Care setting. International Journal of Health Sciences. 2012;6:2,109-115.
14. Feldman E, Stevens MJ, Thomas PK, Brown MB, Canal N, Greene DA. A practical two-step quantitative clinical and electrophysiological assessment for the diagnosis and staging of diabetic neuropathy. Diab Care. 1994;17(11):1281-89.
15. American Diabetes Association. Standards of Medical Care in Diabetes. Diab Care. 2015;38:1.
16. Dyck PJ, Karnes JL, O'Brien PC, Litchy WJ, Low PA, Melton LJ. The rochester diabetic neuropathy study: Reassessment of tests and criteria for diagnosis and staged severity. Neurology. 1992;42:6.

APPENDIX A

Filipino version of the MNSI questionnaire

Filipino version of Michigan Neuropathy Screening Instrument
Bersyon para sa Pasyente

A. Kasaysayan (Sasagutan ng taong may diabetes)

Mangyaring sagutin po ang sumusunod na katanungan tungkol sa nararamdaman mo sa iyong mga binti at paa. Itsek ang oo o hindi base sa karaniwan mong nararamdaman. Salamat po.

1. Namamanhid ba ang iyong mga binti at/o paa?
   Oo Hindi
2. Nakararanas ka ba ng nakapapasong kirot sa iyong mga binti at/o paa?
   Oo Hindi
3. Masyado bang sensitibo ang iyong mga paa kapag hinahawakan?
   Oo Hindi
4. Nakararanas ka ba ng pamumulikat ng mga binti at/o paa?
   Oo Hindi
5. Nakararamdam ka ba ng parang tinutusok-tusok ang iyong mga binti o paa?
   Oo Hindi
6. Makirot ba ang pagdampi ng kumot sa iyong balat?
   Oo Hindi
7. Kapag naliligo, nasasabi mo ba kung mainit o malamig ang tubig?
   Oo Hindi
8. Nagkaroon ka na ba ng bukas na sugat sa paa?
   Oo Hindi
9. Nasabihan ka na ba ng iyong doktor na mayroon kang diabetic neuropathy?
   Oo Hindi
10. Madalas ka bang nakararamdam ng panghihina ng buong katawan?
    Oo Hindi
11. Ang mga sintomas mo ba ay mas malala sa gabi?
    Oo Hindi
12. Kumikirot ba ang iyong mga binti kapag naglalakad?
    Oo Hindi
13. Nararamdaman mo ba ang iyong mga paa kapag naglalakad?
    Oo Hindi
14. Masyado bang tuyot ang balat sa iyong mga paa na nagbibiyak-biyak ito?
    Oo Hindi
15. May nagawa na bang pagputol sa parte ng iyong katawan?
    Oo Hindi

Total: _____

APPENDIX B

MNSI Clinical Examination

MICHIGAN NEUROPATHY SCREENING INSTRUMENT

B. **Physical Assessment** (To be completed by health professional)

1. Appearance of Feet

	Right	**Left**
a. Normal	◯0 Yes ◯1 No	Normal ◯0 Yes ◯1 No
b. If no, check all that apply:		If no, check all that apply:
Deformities	◯	Deformities ◯
Dry skin, callus	◯	Dry skin, callus ◯
Infection	◯	Infection ◯
Fissure	◯	Fissure ◯
Other	◯	Other ◯
specify: _____		specify: _____

	Right		**Left**	
	Absent	Present	Absent	Present
2. Ulceration	◯0	◯1	◯0	◯1

		Present/			Present/	
	Present	Reinforcement	Absent	Present	Reinforcement	Absent
3. Ankle Reflexes	◯0	◯0.5	◯1	◯0	◯0.5	◯1

	Present	Decreased	Absent	Present	Decreased	Absent
4. Vibration perception at great toe	◯0	◯0.5	◯1	◯0	◯0.5	◯1

	Normal	Reduced	Absent	Normal	Reduced	Absent
5. Monofilament test	◯0	◯0.5	◯1	◯0	◯0.5	◯1

Signature: _____ Total Score: _____ /10 Points

Peer-review history:
The peer review history for this paper can be accessed here:
https://sdiarticle4.com/review-history/51408