

# Grading the loss of sensation in diabetics. A Mokken scale analysis.

## Results from the Rotterdam Diabetic Foot Study

Willem D. Rinkel MD, M. Hosein Aziz BSc, Johan W. Van Neck PhD, J. Henk Coert MD, PhD

Departments of Plastic-, Reconstructive- and Handsurgery, Erasmus Medical University, Franciscus Gasthuis, Utrecht Medical University, the Netherlands

### Introduction

Diabetic sensorimotor polyneuropathy (DSP) is the greatest risk factor for diabetic foot ulceration. In the Rotterdam Diabetic Foot Study (RDF-study) we assess the sensation of the feet and varying symptoms of DSP, with several screening instruments. Until now, we estimated by expert opinion how these tests compare to each other and how they roughly reflect the stage of DSP. Current guidelines recommend screening with a monofilament of 10 g. A cutaneous threshold of  $\geq 10$  g is a risk for foot ulceration, so already quite severe and late in the natural course of DSP. Other measurements, like two-point discrimination, have proven to be an earlier indicator of nerve pathology and might be able to detect earlier alterations in sensation of the feet.

**The aim of this study is develop a hierarchical scale of measures of DSP, in order to scale the patient in the natural history of DSP.**

### Methods

We determined the sensation of the feet of 416 patients with one point discrimination (S1PD), two point discrimination (S2PD and M2PD) and vibration sense. To investigate the scalability and the ordering of the items studied, we used Mokken scale analysis. This analysis can be viewed as a nonparametric approach to the item response theory (IRT).

### Conclusion

These results show the first quantitative measure of a scale meeting certain criteria. S2PD, M2PD, vibration sense and S1PD are lost consecutively, making it possible to grade the loss of sensation at the feet reliable, in diabetics.

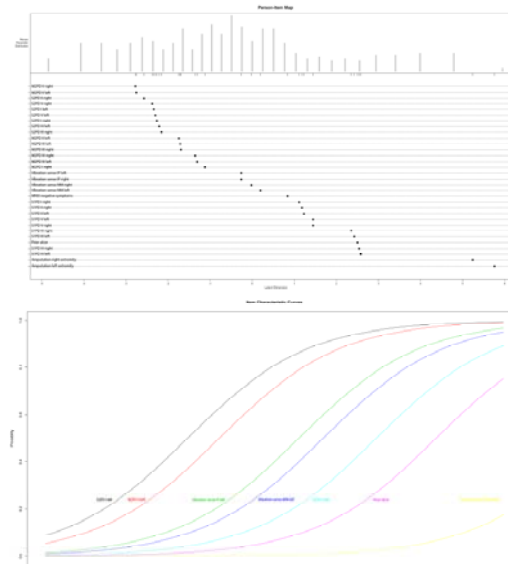
This is the key to reliably monitor the diabetic at risk, during the natural history of loss of sensation.

### Results

A total of 416 patients with diabetes were included in the RDF study. The group represents the diabetic patients followed in this outpatient clinic, with varying degrees of loss of sensation.

41 of 44 items had a strong fit of the MH model ( $H = 0.544$ ), which indicates that the item set can be used for the measurement of this group of patients. The scalability coefficient of the scale  $H$  was 0.544, indicating a strong scale.

The criteria for invariant item ordering were met. This means a hierarchical ordering is possible from the sensibility tests used (from items indicating minor sensory disturbances to more severe forms of sensory loss). In this study, the order of tests indicating severe loss of sensibility to normal sensibility at the feet was the same for all patients, ranging from no or minor to severe impaired sensibility.



The intra-test reliability coefficient  $\rho$  was 0.966, which indicates that the intra-test reliability was stable enough for decisions about individual patients. A Person-Item plot (above) was drawn to see how the tests relate to each other and if certain items are grouped, giving the same estimate of the underlying ability. This was done using IIO.

An Item-characteristic curve was plotted (above). This graph shows the probability of having other abilities when one item is scored. By using IIO, the non-intersections of the items were established and graphically displayed, as possible logical steps on the scale. For example, when S2PD is present at the first toe, the probability that that feet suffered from amputation of toes is low.