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The prevalence and severity of disease-related disabilities and their impact on quality of life in neuromuscular diseases

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ABSTRACT

Purpose: People with neuromuscular disease experience lower quality of life levels than people from the general population. We examined the prevalence and severity of a broad range of neuromuscular disease-related disabilities and their impact on health-related quality of life.

Materials and methods: A cross-sectional postal survey study was conducted among patients diagnosed with neuromuscular disease. Patients completed the Neuromuscular Disease Impact Profile, a disease-related disability impact questionnaire, and two generic health-related quality of life questionnaires: the medical outcome study Short Form Questionnaire and the World Health Organization Quality of Life-bref. The impact of disabilities on quality of life was estimated using multiple regression analyses.

Results: Six hundred sixty two patients (68\% response rate) completed the questionnaires. There were no differences in quality of life between diagnosis-based subgroups. ‘Impairments in muscle functions’ had the highest prevalence and severity scores in the total sample and diagnosis-based subgroups. Neuromuscular disease-related disabilities showed strong and independent associations with all aspects of health-related quality of life. ‘Impairments in mental functions and pain’ was the most important predictor of health-related quality of life followed by ‘restrictions in participation in life situations’.

Conclusions: Although ‘impairment in muscle functions’ is the most prevalent and severe disability, the ‘impairments in mental functions and pain’ have a strong association with health-related quality of life in patients with a neuromuscular disease.

IMPLICATIONS FOR REHABILITATION

• Disease-related disabilities have a strong and independent associations with all aspects of health-related quality of life.
• Although health-related domains of quality of life are affected by the neuromuscular disease, the general quality of life is quite good.
• The most prevalent and severe disability in total group and diagnosis-based subgroups is ‘impairments in muscle functions’.
• The most significant predictor in health-related quality of life is ‘impairments in mental functions and pain’.

Introduction

Neuromuscular diseases (NMDs) can be caused by dysfunction of the anterior horn cell or sensory ganglion cell (neuropathy), peripheral nerve (neuropathy), neuromuscular junction (myasthenia), or muscle (myopathy) \cite{1}. Common impairments in functioning as a consequence of neuromuscular diseases include muscle weakness, impairment in muscle endurance, involuntary muscle activity (stiffness, myotonia, cramp and fasciculation), sensory loss, autonomic dysfunction and impairment in the control of voluntary movements \cite{1}. These impairments cause fatigue and pain in most people, which has a profound impact on their daily activities and participation in life situations \cite{1–5}.

Quality of Life (QoL) has become increasingly important in evaluating healthcare outcomes in recent decades. Commonly, general quality of life is the perceived quality of an individual’s daily life, including physical, psychological, social and environmental aspects of the individual’s life \cite{6,7}. In healthcare, health-related quality of life (HRQoL) is the perceived quality of life when affected by a disease or disabilities \cite{8}. Several studies found that all QoL domains were worse in NMD-groups compared to healthy people in the general population \cite{5}, which can be explained by NMD-related health problems such as poorer physical \cite{5,9} and social functioning \cite{10,11}, pain \cite{12–14}, fatigue \cite{15}, cognitive impairments and impaired emotional functioning \cite{16}.

Although these studies have generated clinically important information, they are limited by their typical focus on the impact of individual disabilities on HRQoL. Little is known of the relative impact of aggregated NMD-related disabilities on HRQoL.
into this could facilitate our understanding of the impact of disease-related disabilities in NMDs on HRQoL.

The aim of this study is therefore to examine the prevalence and severity of a large number of disease-related disabilities and their impact on HRQoL in a sample of patients diagnosed with a wide range of NMDs.

**Methods**

**Sample and procedure**

A cross-sectional postal survey was conducted among patients diagnosed with an NMD and registered at the Department of Neurology, University Medical Center Groningen, The Netherlands. The inclusion criteria in addition to an NMD diagnosis were: being aged 18 or older, and being able to read and write in Dutch.

A total of 980 eligible patients diagnosed with a neuromuscular disease were selected from the hospital patient record system. To avoid inappropriately sending questionnaires, we crosschecked for deceased patients using the national population register.

Patients received information about the study and were invited to participate. Respondents completed the Neuromuscular Disease Impact Profile (NMDIP), two generic health-related QoL questionnaires and some demographic and disease-specific questions. Reminders were sent after two weeks if there was no response.

**Measurement instruments**

Disease-related disabilities were assessed using the NMDIP [1]. This measurement instrument is based on the International Classification of Functioning, Disability and Health (ICF) [17] and consists of 36 items covering four ICF components. Its items are grouped into eight scales with four additional items. For the body functions and participation component items, scoring options ranged from 0 (no disability) to 4 (complete disability); for the activities component items, scoring options ranged from 0 (no disability) to 3 (complete disability); and for the environmental factors component items, scoring options ranged from 0 (no support) to 2 (full support). Scores are summed for each scale.

To make the scores for each scale and the individual items comparable, the summed and individual scores were divided by the highest possible score and multiplied by 100 to obtain a result between 0 and 100. We established in previous work that the NMDIP shows satisfactory levels of internal consistency: Cronbach’s alphas ranged from 0.63 to 0.92, while mean inter-item correlations ranged from 0.38 to 0.77 [1]. Test-retest reliability was good: intraclass correlations ranged from 0.79 to 0.97 [18].

HRQoL was assessed using two generic HRQoL measurement instruments, the Medical Outcome Study 36-item Short Form Health Survey (SF-36) [19] and the World Health Organization Quality of Life (abbreviated version) (WHOQoL-bref) [20]. The SF-36 consists of eight scales and two separate questions covering physical, psychological, and social aspects of health. Item scores were coded, summed, and transformed to a scale ranging from 0 (worst QoL) to 100 (best QoL) for each dimension. The Cronbach’s alpha for a recent NMD study ranged from 0.77 to 0.94 [1]. The WHOQoL-bref consists of 26 items divided into four domains covering physical, psychological, social and environmental aspects and has two single-item questions. For each scale, item scores were coded, summed, and transformed to a scale ranging from 0 (worst QoL) to 100 (best QoL). The Cronbach’s alpha for a recent study of NMD patients ranged from 0.60 to 0.84 [1]. Contextual variables were assessed using three questions with a visual analogue scale: General health status was assessed using the EuroQol-visual analogue scale for the single question ‘How good or bad is your health today?’ [21], with the endpoints ‘Best imaginable health state’ scoring 100, and ‘Worst imaginable health state’ scoring 0. The extent of limitations was assessed using the single question ‘To what extent are you limited due to your NMD?’ Response options are on a 10-point scale ranging from 1 (not limited at all) to 10 (completely limited). And general QoL was assessed using the single question ‘How do you rate your QoL?’, with the endpoints ‘Best imaginable QoL’ scoring 10, and ‘Worst imaginable QoL’ scoring 0.

**Diagnosis-based subgroups**

To examine the differences in the prevalence and severity of disabilities between the relevant NMD subgroup we used the categorisation according to Rowland [22]: motor-neuron disorders, muscle disorders, junction disorders, and peripheral nerve disorders. Furthermore, the peripheral nerve disorders group was split into primary motor and primary sensor subgroups because of the differences in onset and expected differences in prevalence and disability severity.

**Data analyses**

Descriptive statistics were used to examine the patient characteristics. The prevalence of disabilities was calculated as the percentage of the patients who experience a disability (score >0). Severity scores were calculated as the mean score of the disability scores of all patients. To assess differences between diagnosis-based subgroups, analysis of variance and T-tests were performed for normally distributed continuous variables, a Chi-square test for categorical variables, and a Mann–Whitney U-test and Kruskal–Wallis test for not normally distributed variables.

The impact of the disease-related disabilities on HRQoL was assessed using a series of multiple regression analyses with each of the HRQoL variables as dependent variable. We first analysed the impact of patient characteristics (age, gender, years since diagnosis, employment status, and educational level) on HRQoL in Model 1 to control for patient characteristics. We then analysed the impact of the disease-related disabilities overall in Model 2. Before being entered into the regression analysis, the ordinal and categorical variables – gender, educational level and employment status – were dichotomized. The expected direction of standardized sz weights is negative, meaning that less disability equates to better HRQoL. Special attention was given to examining the multicollinearity between variables [23].

Statistical analyses were performed using the SPSS 23.0 software package, SPSS Inc. Chicago, IL 60606-6307.

**Results**

**Patient characteristics**

Of the 980 eligible patients, 662 participants completed the questionnaires (68% response rate). The distribution of NMD diagnoses across the various NMD subgroups is described in Supplementary Table S1. Non-respondents did not differ from respondents in terms of gender, but were younger than respondents (mean age =53, SD = 19.4).

The mean age of respondents was 59 years and their mean disease duration was 11 years (Table 1). Most respondents were married or in a relationship, were of low education level and were retired. All NMD-subgroups had similar levels of general QoL.
Prevalence and severity of disease-related disabilities

The most prevalent disability reported in the total sample (Table 2) was ‘impairments in muscle functions’, followed by ‘limitations in activities of moving around’ and ‘impairments in mental functions and pain’. The peripheral nerve disorders subgroup, primary sensor group, had the highest prevalence for ‘impairments in mental functions and pain’ and for ‘impairments in excretion and reproductive functions’ compared to the other disorders. The most severe disability in the total sample was ‘impairments in muscle functions’ followed by ‘lack of support from social security services’ and ‘health services’, and ‘limitations in activities of moving around’. Disability severity differed statistically significantly for most disabilities between NMD subgroups.

Impact of disease-related disabilities on QoL

We obtained satisfactory results, and there was no multicollinearity: the variance inflation factor (VIF) for ‘activities of moving around’ was 5.6 and the average VIF was 2.0. The mean tolerance was 0.59 and the range was from 0.20 to 0.85 and was never below the critical value of 0.2.

Disease-related disability variables contributed significantly and considerably to an important segment of the variance for all SF-36 and WHOQoL-bref domains. The significant standardized β weights were in the expected direction, meaning that patients who reported more disability experienced less QoL. The low significant positive direction of the β weight for the variable ‘seeing functions’ in relation to the SF-36 variable bodily pain was somewhat unexpected.

The disabilities which were strong predictors for QoL evaluated using the SF-36 (Table 3) were:

- ‘Impairments in mental functions and pain’ (impairments in sleep functions, fatigue, emotional functions, thought functions, and sensation of pain) was a significant predictor for six out of eight QoL variables.
- ‘Impairments in muscle functions’ (impairments in muscle power functions and muscle endurance functions) and ‘limitations in activities of moving around’ (limitations in changing body position, maintaining body position, transferring oneself, walking, using transportation, and recreation and leisure) were important predictors in the ‘physical functioning’ QoL domain.
- ‘Restrictions in participation in life situations’ (restrictions in mobility, relationships and recreation and leisure) was an important predictor in the ‘role physical’ and ‘social functioning’ QoL domains.
- ‘Restrictions in self-care and domestic activities’ (limitations in fine hand use, hand and arm use, washing oneself, caring for body parts, going to the toilet, dressing, preparing meals, and doing housework) and ‘restrictions in mental functions and pain’ were important predictors in the ‘role emotional’ QoL domain.

The disabilities which were strong predictors for QoL evaluated using the WHOQoL-bref (Table 4) were:

- ‘Restrictions in participation in life situations’ was a significant predictor for three out of four QoL variables.
- ‘Impairments in mental functions and pain’ was an important predictor in the ‘physical health’ and ‘psychological health’ QoL domains.
- ‘Impairments in excretion and reproductive functions’ (impairments in defecation functions, urination functions, and sexual functions) was an important predictor in the ‘social relations’ QoL domain.
- ‘Lack of support from immediate family’ and ‘lack of support from social security services’ showed significant contributions in the ‘social relationships’ QoL domain.
- ‘Lack of support from immediate family’ showed a significant contribution in the ‘environment’ QoL domain.

Discussion

This study examined the prevalence, severity and impact of a broad range of disease-related disabilities on HRQoL in a large sample of NMD patients. The study’s most important finding is that disease-related disabilities have a strong and independent association with all aspects of HRQoL. Although ‘impairments in muscle functions’ was the most severe disability with the highest prevalence in all diagnosis-based subgroups, the ‘impairments in
Peripheral nerve disorders (n = 155) vs. motor-sensory disorders (n = 155)

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Mean (SD)</th>
<th>CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impairments in Movement Functions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor-sensory</td>
<td>44.8 (43.0)</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peripheral nerve</td>
<td>44.8 (43.0)</td>
<td></td>
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<tr>
<td>Motor-neuron</td>
<td>22.0 (20.5)</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peripheral nerve</td>
<td>22.0 (20.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Impairments in Medical Diagnosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor-sensory</td>
<td>51.9 (49.6)</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peripheral nerve</td>
<td>51.9 (49.6)</td>
<td></td>
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</tr>
<tr>
<td>Motor-neuron</td>
<td>32.2 (30.1)</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peripheral nerve</td>
<td>32.2 (30.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Impairments in Self-care and Domestic Activities</strong></td>
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<tr>
<td>Motor-sensory</td>
<td>15.7 (14.0)</td>
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<tr>
<td>Peripheral nerve</td>
<td>9.3 (8.9)</td>
<td></td>
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</tr>
</tbody>
</table>

**Table 2. Prevalence and severity of disease-related disabilities in the total sample and in disease subgroups.**

We found significant differences between motor-neuron disorders and peripheral nerve disorders, with motor-neuron disorders reporting more severe impairments in movement functions and medical diagnosis. However, no significant differences were observed between the two peripheral nerve disorders subgroups. This indicates that the type of peripheral nerve involvement may play a role in the severity of impairments.

**Discussion:***

Our findings suggest that the type of peripheral nerve involvement may influence the severity of impairments. Future research should explore the mechanisms underlying these differences and their implications for HRQoL.

**Conclusion:***

Peripheral nerve disorders, especially involving motor-neuron, present with higher severity of impairments compared to peripheral nerve disorders. Further research is needed to understand the underlying mechanisms and to develop targeted interventions for improving HRQoL in these patients.
Our study has some important strengths. First is the fact that we examined the impact on HRQoL of a broad range of disease-related disabilities, separately and in relation to each other, while most studies examined only one or some disabilities in one or some NMDs. As a result, this study offers a unique insight into the consequences of NMD. Second, this study examined the consequences of a large sample of NMDs representing all acknowledged diagnosis-based subgroups and not just one disease or a few diseases as is usually the case. Combined with our finding that it is the disease-related disabilities rather than the medical diagnosis, which are relevant to predicting HRQoL, our findings are relevant to a broad population and could have important implications for the treatment of patients with chronic diseases such as NMD. Insight into the prevalence, severity and relative impact of a large number of disease-related disabilities could contribute to medical and non-medical support of NMD patients. Furthermore, if the focus of support is shifted from medical diagnoses to disabilities, the professionals who support patients with a
chronic disease might exchange knowledge and experiences, or could integrate their activities. This ‘joining forces’ could contribute to the QoL of the chronically ill.

Conclusions

Although impairment of muscle function is the most prevalent and severe disability, impairment of mental function and pain have a strong association with HRQoL of NMD patients.

Ethical approval

Ethical approval was obtained from the local ethics committee, the Medical Ethical Committee of the University Medical Center Groningen. Reference: METc 2009.310. Informed consent was obtained from all participants.

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Disclosure statement

The authors report no declarations of interest.

Reference