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Quality of life in patients with slowly progressive neuromuscular disorders dependent on mechanical ventilation

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ABSTRACT

This cross-sectional study evaluated health-related quality of life (HRQoL) in patients with slowly progressive neuromuscular disorders dependent on mechanical ventilation (MV; ≥ 16 hours/day). 119 participants, with 9 years (25th–75th percentiles: 4–15 years) of MV dependence, were included. MV was applied via a tracheostomy in 80 participants (67.2%) and non-invasive interfaces in 39 participants (32.8%), including 28 participants (71.8%) with daytime mouthpiece ventilation. HRQoL was rated good or excellent by 81 participants (68.1%), independently from age, diagnosis or respiratory autonomy. On multivariate analysis, time since MV initiation, independence from family member(s), residence in a rural area, ability to go outdoors with MV and tracheostomy were associated with better HRQoL.

INTRODUCTION

Respiratory insufficiency is among the leading causes of death in patients with slowly progressive neuromuscular disorders (NMD).¹ The need for mechanical ventilation (MV) is, therefore, considered at early stages of disease evolution.^{2,3}

However, despite optimal ventilatory management, disease progression may lead to an increase in MV needs. The longer life expectancy is at the cost of MV dependence, which may impact health-related quality of life (HRQoL).

The primary objective of this study was to assess HRQoL in patients with slowly progressive NMD dependent on MV, either non-invasive (NIV) or invasive mechanical ventilation (IMV; via a tracheostomy). Our secondary objective was to identify factors associated with HRQoL in this population.

METHODS

Additional information about the methods is available in the online supplemental file 1.

Participants

Participants were identified via the AFM-Téléthon organisation. Adults who had slowly progressive NMD, were wheelchair bound or bedridden and were dependent on NIV or IMV (≥ 16 hours/day for at least the past year) were eligible. The following diseases were defined a priori as not eligible: amyotrophic lateral sclerosis, myasthenia, polyradiculoneuritis and metabolic neuropathies.

Data collection

Each participant completed a questionnaire collecting the variables listed in the online supplemental table 1, and two validated and standardised HRQoL questionnaires: the Severe Respiratory Insufficiency Questionnaire (SRI), developed for patients with chronic respiratory failure,⁴ and the Quality of Life in genetic Neuromuscular Disease Questionnaire (QoL-gNMD), developed for patients with slowly progressive NMD.⁵ Each HRQoL score presented hereafter ranges from 0 to 100, with higher scores indicating better HRQoL.

Statistical analysis

We built multivariate linear regression models to identify factors associated with the SRI summary scale (SRI-SS) and with scores on each of the three QoL-gNMD domains (impact of physical symptoms (QoL-gNMD-PS), self-perception (QoL-gNMD-SP) and activities and social participation (QoL-gNMD-ASP)). Each multivariate model was adjusted for age, diagnosis (dystrophinopathy vs other diseases) and factors associated with p values of <0.20 by univariate analysis and identified by stepwise selection.

We compared groups with IMV versus NIV using Student's t-test, the Mann-Whitney U test, the χ^2 test and Fisher's exact test, where appropriate. All tests were two-tailed and p values of <0.05 were considered significant.

RESULTS

Between December 2020 and December 2021, 119 participants distributed throughout France were enrolled. Online supplemental figure 1 is the flow chart. Table 1 reports the main features of the participants. Of the 39 patients (32.8%) on NIV, the most common daytime interface was mouthpiece (28 participants (71.8%)). Additional information about the results is provided in online supplemental file 1.

Health-related quality of life

As assessed based on the two general QoL-gNMD items, health status and HRQoL were 'good or excellent' for 75 participants (63.0%) and 81 participants (68.1%), respectively. Only 4 participants (3.4%) described their HRQoL as poor (online supplemental figure 2). The mean SRI-SS score was 56.1 ± 14.6 (range: 15.9–86.5). Consistently with the inclusion criteria, physical functioning was the most severely impaired SRI domain (18.9 ± 14.8 ;



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Table 1 Main features of the study participants and in the groups with IMV (via a tracheostomy) versus NIV

	All patients (n=119)	NIV (n=39)	IMV (n=80)	P value
Features				
Age, years	37.0 (29.0–46.5)	35.0 (27.0–47.5)	37.5 (31.0–46.0)	0.439
Female sex, n (%)	35 (29.4)	9 (23.1)	26 (32.5)	0.290
BMI, kg/m ²	21.2 (16.5–24.7)	19.0 (15.4–24.2)	21.4 (18.0–25.3)	0.129
Diagnosis, n (%)				
Dystrophinopathy				
Duchenne muscular dystrophy	59 (49.6)	23 (59.0)	36 (45.0)	
Becker muscular dystrophy	2 (1.7)	–	2 (2.5)	
Limb girdle muscular dystrophy	15 (12.6)	11 (28.2)	4 (5.0)	
Congenital muscular dystrophy	9 (7.6)	2 (5.1)	7 (8.8)	
Facioscapulohumeral dystrophy	4 (3.4)	–	4 (5.0)	
Congenital myopathy	4 (3.4)	1 (2.6)	3 (3.8)	
Glycogen storage disease type 2	2 (1.7)	1 (2.6)	1 (1.3)	
Steinert myotonic dystrophy	1 (0.8)	–	1 (1.3)	
Spinal muscular atrophy				
SMA 1b	9 (7.6)	1 (2.6)	8 (10.0)	
SMA 2	7 (5.9)	–	7 (8.8)	
SMA 3	1 (0.8)	–	1 (1.3)	
Other neuromuscular disorder				
Myofibrillar myopathy	1 (0.8)	–	1 (1.3)	
Charcot-Marie-Tooth disease	1 (0.8)	–	1 (1.3)	
Inclusion body myositis	1 (0.8)	–	1 (1.3)	
Undetermined NMD	3 (2.5)	–	3 (3.8)	
Respiratory care				
Time since MV initiation, years	17.0 (10.0–21.0)	11.0 (8.3–16.8)	19.0 (11.5–23.0)	0.001
Time since onset of MV dependence*, years	9.0 (4.0–15.0)	6.0 (3.3–9.8)	11.0 (5.3–17.0)	<0.001
Respiratory autonomy, min	10.0 (2.0–90.0)	18.8 (3.3–113.0)	5.0 (1.5–60.0)	0.077
Requirement for airway clearance techniques, n (%)	80 (67.2)	20 (51.3)	60 (75.0)	0.010
Airway clearance sessions, n/week	3.0 (0.0–7.0)	0.0 (0.0–2.5)	7.0 (0.0–7.0)	<0.001
Functional autonomy				
Personal assistant every day, n (%)	83 (69.7)	24 (61.5)	59 (73.8)	0.173
In bed most of the time, n (%)	11 (9.2)	2 (5.1)	9 (11.3)	0.337
Can go outdoors with MV, n (%)				0.143
Yes, alone	20 (16.8)	9 (23.1)	11 (13.8)	
Yes, with a caregiver†	96 (80.7)	28 (71.8)	68 (85.0)	
No	3 (2.5)	2 (5.1)	1 (1.3)	
Assistance required during meals, n (%)	108 (90.8)	36 (92.3)	72 (90.0)	1.0
Duration of main meal, min	40.0 (30.0–60.0)	30.0 (30.0–52.5)	40.0 (30.0–60.0)	0.297
Place of residence, n (%)				
Urban area	66 (55.5)	28 (71.8)	38 (47.5)	0.005
Medico-social institution	18 (15.1)	3 (7.7)	15 (18.8)	0.114
Living arrangements, n (%)				
Lives alone or in shared accommodations‡	42 (35.3)	8 (20.5)	34 (42.5)	0.018
Lives with a partner	19 (16.0)	7 (17.9)	12 (15.0)	0.680
Lives with other family members	57 (47.9)	24 (61.5)	33 (41.3)	0.038
Other variables				
Interactions with healthcare workers\$, days/week	3.0 [0.0–7.0]	2.0 [2.0–4.0]	7.0 [3.0–7.0]	<0.001
Psychotropic medication, n (%)	24 (20.3)	3 (7.7)	21 (26.3)	0.017
Inclusion during a COVID-19 lockdown, n (%)	49 (41.2)	15 (38.5)	34 (42.5)	0.674
Level of education, n (%)				
Elementary school	10 (8.4)	1 (2.6)	9 (11.3)	0.094

Continued

Table 1 Continued

	All patients (n=119)	NIV (n=39)	IMV (n=80)	P value
Middle school	24 (20.2)	9 (23.1)	15 (18.8)	
High school	38 (31.9)	9 (23.1)	29 (36.3)	
University	46 (38.7)	20 (51.3)	26 (32.5)	
Professional activity, n (%)	9 (7.6)	4 (10.3)	5 (6.3)	0.438

Data are presented as n (%) or median (25th–75th percentiles).
*MV dependence was defined as daily ventilation ≥ 16 hours/day for at least the past year.
†Caregiver was defined as a family member, personal assistant or healthcare worker.
‡The patients in sharing arrangements did not require help from those living in the same home.
§Healthcare workers were defined as nurses or physiotherapists.
BMI, body mass index; IMV, invasive mechanical ventilation; MV, mechanical ventilation (non-invasive or invasive); NIV, non-invasive ventilation; NMD, neuromuscular disorder; SMA, spinal muscular atrophy.

range: 0–54.2). Of the QoL-gNMD domains, activities and social participation had the lowest mean score (43.1 ± 8.6 ; range: 24.2–62.7).

Figure 1 and online supplemental table 2 report the scores on the SRI subscales and QoL-gNMD domains, comparing groups with IMV versus NIV. The SRI-SS score was significantly better in the IMV group than in the NIV group (57.9 ± 13.6 and 52.2 ± 16.0 , respectively; $p=0.046$). This difference was mainly due to the lesser intensity of respiratory complaints (online supplemental figure 3) and anxiety in the IMV group. Scores for all three QoL-gNMD domains were better with IMV than with NIV, but this difference was not significant and should be interpreted with caution.

Factors associated with HRQoL

Online supplemental tables 1 and 3 report the results of the univariate analyses. HRQoL was not associated with age, overweight, diagnosis of dystrophinopathy versus other NMD, inclusion during a COVID-19 national lockdown, daily presence of a personal assistant, level of education or residence in a medical institution.

Table 2 shows the results of the multivariate analyses. A better SRI-SS score was associated with a longer time since MV initiation at study inclusion, residence in a rural area and living independently from a partner or other family member(s). A longer time since MV initiation, tracheostomy and ability to

go outdoors with MV were associated with better scores for the QoL-gNMD-PS, QoL-gNMD-SP and QoL-gNMD-ASP domains, respectively.

DISCUSSION

From these results, it should be emphasised that HRQoL was perceived as good or excellent by over two-thirds of MV-dependent patients with slowly progressive NMD. Although there is strong agreement that HRQoL is a major goal in patients treated with long-term MV,⁶ assessment of HRQoL in daily clinical practice can be far from optimal and should deserve greater attention.

Our results also highlight that, even though often viewed as a negative step, tracheostomy was not associated with poorer HRQoL. A 1993 report indicated a preference for NIV over tracheostomy for safety, comfort, speech, swallowing and appearance.⁷ Since then, however, long-term IMV techniques have improved considerably, allowing speech and eating during MV (as shown in online supplemental figure 3).^{8,9} Importantly, in our study, more than 80% of the participants ventilated through IMV did not necessitate to move into a medical institution, and two-fifths of them lived alone or shared accommodations compared with only one-fifth of patients using NIV. Tracheostomy was not a barrier to independence.

The limitations of our study include the occurrence during the

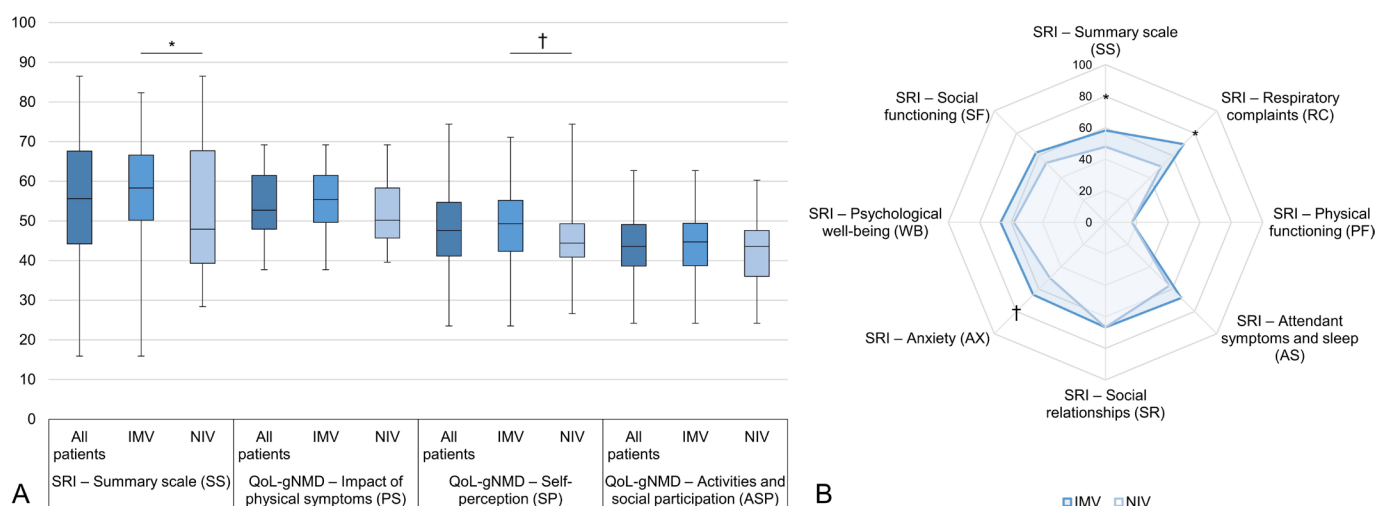


Figure 1 Scores on the SRI and QoL-gNMD. The scores for each domain can range from 0 to 100, with higher scores indicating better quality of life. The box plots represent quality-of-life scores for all participants and comparison between groups with IMV versus NIV (A). The radar plots represent the different domains of the SRI in the groups with IMV versus NIV (B). Comparison between groups with IMV versus NIV: * $p<0.05$; † $p<0.1$. See online supplemental table 2 for more information. IMV, invasive mechanical ventilation; NIV, non-invasive ventilation; QoL-gNMD, Quality of Life in genetic Neuromuscular Disease Questionnaire; SRI, Severe Respiratory Insufficiency Questionnaire

Table 2 Multivariate analyses

	SRI-SS			QoL-gNMD-PS			QoL-gNMD-SP			QoL-gNMD-ASP		
	β (95% CI)	P value	R ²	β (95% CI)	P value	R ²	β (95% CI)	P value	R ²	β (95% CI)	P value	R ²
NIV	-	-	0.21	-	-	0.05	-4.92 (-9.44 to -1.11)	0.017	0.06	-	-	0.10
Time since MV initiation, years	0.30 (0.03 to 0.57)	0.027		0.20 (0.01 to 0.33)	0.030		-	-		-	-	
Residence in an urban area	-5.57 (-10.46 to -0.67)	0.026		-	-		-	-		-	-	
Lives with a partner or other family member(s)	-10.32 (-15.36 to -5.28)	<0.0001		-	-		-	-		-	-	
Can go outdoors with MV*											0.003	
Yes, with a caregiver†	-	-		-	-		-	-		-3.88 (-8.01 to 0.00)	0.057	
No	-	-		-	-		-	-		-17.18 (-27.26 to -7.09)	0.001	

The data are estimates (β) and 95% CIs.

Positive values indicate that the variable was associated with better quality of life.

*Reference: yes, alone.

†Caregiver was defined as a family member, personal assistant or healthcare worker.

MV, mechanical ventilation (non-invasive or invasive); NIV, non-invasive ventilation; QoL-gNMD, Quality of Life in genetic Neuromuscular Disease Questionnaire; QoL-gNMD-ASP, Quality of Life in genetic Neuromuscular Disease Questionnaire-self-perception; activities and social participation; QoL-gNMD-PS, Quality of Life in genetic Neuromuscular Disease Questionnaire-impact of physical symptoms; QoL-gNMD-SP, Quality of Life in genetic Neuromuscular Disease Questionnaire-self-perception; SRI-SS, Severe Respiratory Insufficiency Summary Scale.

recruitment period of several COVID-19 national lockdowns, which may have decreased the willingness of patients to participate in a study on such a topic at a time when quality of life was constrained for everyone. This may have induced selection bias toward patients with better perceived HRQoL. Also, participants were recruited via a single organisation (AFM-Téléthon). However, this recruitment was carried out through 18 services all over France, which suggests a reasonable representativeness of the whole territory. Lastly, the cross-sectional study design precluded assessments of causality.

In conclusion, MV-dependent patients with slowly progressive NMD reported good HRQoL independently from age, diagnosis and respiratory autonomy. Participants with tracheostomy had less respiratory complaints, and a trend toward better self-perception and lower anxiety than participants with NIV, despite requiring a higher level of respiratory care. Additionally, other factors strongly associated with better HRQoL, such as not requiring help from family for daily needs and being able to go outdoors with MV, deserve consideration.¹⁰

Correction notice This article has been corrected since it was published Online First. The licence has been updated to open access CC BY-NC.

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Patient consent for publication Not applicable.

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