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Effects of prolonged interruption of rehabilitation routines in amyotrophic lateral sclerosis patients

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Abstract

Objective. Patients with amyotrophic lateral sclerosis (ALS) experienced prolonged interruption of their rehabilitation palliative care routines due to restrictive COVID-19 pandemic public health measures. This study assesses the effects of before and after the lockdown on functionality rates and quality of life (QoL) in patients with ALS.

Methods. A longitudinal observational study was conducted. Participants were assessed three times — early January (T0), before mandatory lockdown (T1), and during lockdown (T2) — using the ALS Functional Rating Scale-revised (ALSFRS-R), Fatigue Severity Scale (FSS), and the ALS-Specific Quality of Life-Short Form (ALSSQOL-SF). The paired-sample *t-test* and Wilcoxon signed-rank test were used.

Results. Thirty-two patients were included with a mean age of 56.9 (SD 14.2) years and mean symptoms onset of 27.1 (SD 14.3) months. ALSFRS-R mean scores decayed significantly over time when comparing T0–T1 (0.26 ± 0.38) and T1–T2 (1.36 ± 1.43) slopes ($p < 0.001$). Significant differences were observed between T1 and T2 for ALSSQOL-SF scores (115.31 ± 17.06 vs. 104.31 ± 20.65), especially in four specific domains, and FSS scores (34.06 ± 16.84 vs. 40.09 ± 17.63). Negative correlations between negative emotions and physical symptoms assessed by ALSSQOL-SF and FSS were found.

Significance of the results. Rehabilitation treatment routines in palliative care, such as physiotherapy and speech therapy, appear to mitigate the ALSFRS-R slope. Prolonged interruption of rehabilitation during the lockdown may have accelerated the functional decline in ALS patients' motor skills with as measured after 2 months by the ALSFRS-R in the limb and bulbar subscores, but not respiratory subscore. Other short-term effects, increased fatigue and negative impact on QoL, were also verified.

Introduction

Amyotrophic lateral sclerosis (ALS) is a heterogeneous inherited or sporadic neurodegenerative disease characterized by the degeneration of both upper (corticospinal) and lower (spinal and bulbar) motor neurons leading to motor and extra-motor symptoms (Hardiman et al., 2017). The annual median incidence rate in Europe is 2.08/100,000 inhabitants (Chio et al., 2013). Symptom onset types are typically anatomically localized and include extremity muscle deficits, "limb onset," and dysarthria or dysphagia symptoms, "bulbar onset," with a small fraction presenting with respiratory or generalized weakness onset (Hardiman et al., 2017; Pfohl et al., 2018). ALS subsequently spreads into other body regions with progressive muscle weakness and loss of voluntary muscle control of the bulbar, limb, thoracic, and abdominal regions, usually leading to death from respiratory failure, on average 2–5 years after symptom onset, with 5–10% of patients surviving beyond 10 years. During the course of the disease, 20–50% of patients develop cognitive and/or behavioral impairment, and 5–15% develop concomitant dementia, usually frontotemporal dementia (FTD). Other brain functions, and oculomotor and sphincter functions are relatively spared, but may occur in late stages of the disease (Andersen et al., 2012; Gordon, 2013).

Multidisciplinary care is considered standard of care and associated with better quality of life (QoL) and possibly increased survival (Rooney et al., 2015; Hogden et al., 2017). The severity of the illness and uncertainties regarding the time course of disability demands clinical care centered around the patient and carers, with disease-focused expertise offering a multidisciplinary approach that leverages the experience of several healthcare providers in order to control the symptoms and assist the patient to reach their fullest potential and maximum comfort during disease progression (Van den Berg et al., 2005; Paganoni et al., 2015; Hogden et al., 2017). This often involves a weekly rehabilitation treatment routine in palliative care, performed by one or more allied healthcare professionals, such as physiotherapists, speech therapists, occupational therapists, and specialized nurses. Options such as enteral nutrition,

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mechanical ventilation, and disease-modifying therapy drugs (such as *Riluzole*) are also related to prolonged survival in patients with ALS and better QoL (Hardiman et al., 2017; Ng et al., 2017; Paipa et al., 2019).

On 12 March 2020, the World Health Organization declared "Coronavirus disease 2019" (COVID-19), caused by a virus easily spread from close contact, a global pandemic. Actions taken across the country over COVID-19 mandated social distancing measures, temporary lockdown, and closure of all non-essential rehabilitation facilities to minimize the risk of exposure, and especially for high-risk populations such as patients with ALS.

The present study assesses the effects of the lockdown on functionality rates and QoL in ALS patients, comparing data before and during the lockdown.

Methods

Patients and data collection

Thirty-three patients who were observed and evaluated in the first two weeks of January at a Neuromuscular Disease Portuguese Association were enrolled in this longitudinal study. All belong to a population of 131 patients with ALS who routinely receive or are in contact with this Association for follow-up or onsite rehabilitation, providing a convenience non-probabilistic sample.

All patients have definite ALS disease according to the revised El Escorial criteria. Data collection was conducted between 6 January 2020 and 8 May 2020. Patients were assessed three times: during the first two weeks of January (T0); 8–9 weeks later (T1, before mandatory lockdown); and 16–17 weeks after T0 (T2, during lockdown), by the following questionnaires: ALS Functional Rating Scale-Revised (ALSFRS-R) at T0, T1, and T2; Fatigue Severity Scale (FSS); and ALS-Specific Quality of Life-Short Form (ALSSQOL-SF) at T1 and T2. The first two assessments were done at the ALS association, with the latter being done online.

At T0 and T1, ALSFRS-R was assessed by a healthcare professional onsite, as opposed to T2 assessment which was conducted by phone and video call to guarantee its application, by the same professional. Onsite testing of ALSFRS-R is well correlated with online administration within clinical trials follow-up and for profiling and managing the care of patients with ALS (Kasarskis et al., 2005; Maier et al., 2012; Proudfoot et al., 2016; Bakker et al., 2017). Regarding the FSS and ALSSQOL-SF, all patients received instructions at T1 on how to self-administer the instruments, followed by its self-application through digital support available in the Association (which allowed them to correctly fill out all the questions and used alternative/augmentative communication devices if in need). For these instruments, the same digital support was shared at T2 and self-administrated, but at their homes.

ALSFRS-R slopes between T0–T1 and T1–T2 were calculated by subtracting the ALSFRS-R score and subscores between (T0–T1) and (T1–T2) divided by time (in months) between evaluations.

To further explore the differences between the slope decays, a comparison between the values of progression was conducted. The cutoff for "slow progressors" and "fast progressors" was set at 0.77 (rate of decline of the ALSFRS-R units per month lower or higher than 0.77, respectively). Previous data reported slower progression rates when less than 0.44, moderate decline between 0.44 and 1.04, and fast when higher than 1.04 units/month (Gordon et al., 2004), with medium ranges reported from 0.77 to 0.81 (Maier et al., 2012). The last one was used as a reference for our cutoff point.

The ALSFRS-R is a 12 questions instrument designed for monitoring the progression of functional disability in patients with ALS. Each question is rated according to progressive functional impairment from 4 (normal function) to 0 (loss of function/total dependence), with 3, 2, 1 representing progressive worsening of the functional capability. Four subscores, with 3 questions each, are evaluated ranging from 0 to 12: bulbar function (BS) assessing speech, salivation, and swallowing; upper limb function (ULS) assessing handwriting, handling utensils (including for patients with gastrostomy), and dressing-hygiene; lower limb function (LLS) assessing turning in bed walking and climbing stairs; and respiratory function (RS) assessing dyspnea, orthopnoea, and respiratory insufficiency. Total ALSFRS-R score ranges from 0 to 48, resulting from the sum of the 4 subgroups, where higher scores indicate higher functionality.

The FSS assesses fatigue (ranging from 9 to 63, higher scores indicate more fatigue) (Lou, 2012). ALSSQOL-SF is a 20-item disease-specific global QoL instrument, each rated on a Likert-type scale from 0 to 10. Six domains are calculated based on their mean scores: negative emotions (NE), interaction with people and the environment (IPE), intimacy (IN), religiosity (RE), physical symptoms (PS), and bulbar function (BF), an extra item assesses the overall self-perception (SP) of quality of life. NE, PS, and BF domains require transposing (subtracting the score of response from 10) prior to calculating a score, with lower scores indicating worse specific aspects of QoL (Felgoise et al., 2018; Gayoso et al., 2020).

Ethical-legal procedures involved a positive opinion from the committee (n°07/2020). Data confidentiality and anonymity was guaranteed, with the respective data coding. All participants agreed to participate in the study on a voluntary basis through electronic validation of the informed consent that appears as a pre-response.

Data analysis

Descriptive statistics were used to describe participants and their weekly rehabilitation routines. To assess the normality and variance, the Kolmogorov–Smirnov test was performed. Decay between T0–T1 and T1–T2 on ALSFRS-R outcomes was assessed using the paired-sample *t*-test, as normal distribution was confirmed, for global decay and for different onset presentation scrutiny. For further analysis, patients were distributed between three groups, according to their functional capacities and dependency (early, medium, and late-stage patients): group A (ALSFRS-R scores ranging from [0–15], with severe to total functional dependency patients), group B (ALSFRS-R scores ranging from [16–31], moderate to severe functional dependency patients), and group C (ALSFRS-R scores ranging from [32–48], group of mild to moderate functional dependency patients), and the categorized according to the functional decay between the two time points evaluated: being "slow progressors" if the decline was lower than 0.77 units/month, or "fast progressors" if higher (Maier et al., 2012), using McNemar for comparing proportions for related samples.

QoL and FSS outcomes, between T1 and T2, were assessed by the Wilcoxon signed-rank test, for non-normal data distributions. Spearman correlation coefficients were used to examine associations among different variables for non-normal data distributions,

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and values of $p < 0.05$ were considered as significant. *SPSS* package software v. 24 was used.

Results

From the 33 patients with ALS who were evaluated at T0, one (with an ALFRS-R score of 4, total dependency) was excluded because he does not attend any type of therapy, and as per his request, only a daily personal routine of hygiene assistance is performed by a team of homecare formal caregivers. A final 32 patients, with a mean age of 56.9 (±14.2) years, were included in this study. Patients characteristics are shown in Table 1.

During T1–T2, two patients had to attend hospital care; the first went for respiratory testing and evaluation, with adjustments on noninvasive ventilation (NIV) parameters. The second was hospitalized for two days for a percutaneous endoscopic gastrostomy (PEG) procedure due to deterioration of bulbar function.

ALSFRS-R mean values showed a progressive decrease throughout each assessment (Figure 1): at T0 = 26.06 (±8.97), T1 = 25.53 (±8.96), and T2 = 22.81(±7.62). Comparing T0–T1 and T1–T2 ALSFRS-R slopes, decay was significantly different ($p < 0.001$). Significant differences were also found for ALSFRS-R subscores (Table 2): bulbar subscore ($p = 0.009$), upper limbs subscore ($p = 0.005$), and lower limbs subscore ($p = 0.004$), but not for respiratory subscore ($p = 0.18$). A separate analysis was conducted comparing bulbar ($n = 7$) and spinal ($n = 25$) onset patients, for ALSFRS-R progression (T0–T1, $p = 0.145$; T1–T2, $p = 0.371$) and its subscores (upper and lower limb, bulbar function, and respiratory function), but no significant differences were found between the decays.

Ninety percent of the patients presented a slow progression pattern between T0 and T1, with a decline less than 0.77 units/month. This pattern percentage dropped to 45.8% between T1 and T2. For bulbar onset patients ($n = 7$), 28.6% showed a fast progression pattern between T0 and T1, with an increase to 57.1% between T1 and T2. For spinal onset patients ($n = 25$), 4% showed a fast progression pattern between T0 and T1, with an increase to 56% between T1 and T2. Paired-sample analysis performed by the McNemar test showed a significant decay for group C ($p = 0.008$), but not for group A ($p = 1.0$) and B ($p = 0.07$). Based on these results, we explored bulbar/spinal onset form differences in-between group B and in-between group C, for the two time points. Group C ($n = 9$) had only one bulbar subject with a fast progression pattern for both time-frames (T0–T1: 1.0 units/month; T1–T2: 1.5 units/month), with all the spinal patients changing from slower to fast progressions (mean values T0–T1: 0.25 units/month; T1–T2: 2.87 units/month). For group B ($n = 19$), no differences were found between T0–T1 and T1–T2 for bulbar ($p = 0.25$; mean values T0–T1: 0.63 units/month; T1–T2: 1.5 units/month) and for spinal patients ($p = 0.13$; T0–T1: 0.2 units/month; T1–T2: 0.73 units/month). For the bulbar patients group vs. spinal patients group, 8 spinal patients preserved the slow pattern for the different time points assessments, 6 spinal and 2 bulbar patients have accelerated the functional decline from slow to fast, and 1 bulbar patient maintained the faster progression pattern. No cases with a fast to slower pattern shift were observed.

The ALSSQOL-SF means (±SD) scores showed a significant decrease ($p < 0.001$) between T1 (115.31 ± 17.06) and T2 (104.31 ± 20.65) on overall QoL assessment (Figure 2). Differences were also found in four specific domains (mean ± SD): *Negative Emotions* [$p < 0.023$, T1 (7.18 ± 2.78) vs. T2 (6.39 ± 3.25)], *Interactions with People and Environment* [$p < 0.027$, T1 (6.02 ± 2.27) vs. T2 (5.60 ± 2.35)], *Physical Symptoms* [$p < 0.001$, T1 (6.52 ± 2.08) vs. T2 (5.62 ± 2.55)], and *Bulbar Function* [$p < 0.001$, T1 (7.48 ± 2.61) vs. T2 (6.80 ± 3.00)], but not on *Religiosity* or *Intimacy* domains ($p > 0.05$). In addition, *Self-Perception* of QoL also decreased ($p = 0.002$) between T1 (5.19 ± 2.43) and T2 (4.25 ± 2.32).

Table 1. Characteristics of the ALS population included in the study

	At entry
Gender (males %)	68.8 (n = 22)
Onset age (mean ± SD years)	56.9 ± 14.7
Symptoms onset (mean ± SD months)	27.1 ± 14.3
Bulbar/spinal/spinal-axial onset forms (%)	21.9/71.9/6.2 (n = 7/23/2)
Physiotherapy sessions (mean ± SD days/week)	2.6 ± 1.4
Speech therapy sessions (mean ± SD days/week)	1.0 ± 0.89
Other interventions[a] (mean ± SD days/week)	0.4 ± 1.3
Lookdown period (mean ± SD weeks)	8.2 ± 1.1
Patients taking *riluzole* (%)	100 (n = 32)
Patients with PEG[b] (%)	15.6 (n = 5)
Patients using NIV[c] (%)	71.9 (n = 23)

[a]Occupational therapist, specialized nurse.
[b]Percutaneous endoscopic gastrostomy.
[c]Noninvasive ventilation.

An increase in FSS total score was verified, mean values (±SD) were in T1 = 34.06 (±16.84), and at T2 = 40.09 (±17.63), significant differences were found comparing T1 vs. T2 ($p < 0.001$). Negative correlations were found between FSS and *Negative Emotions* and *Physical Symptoms* domains of ALSSQOL-SF, with moderate ($r = -0.58$, $p = 0.001$) and strong correlation ($r = -0.71$, $p < 0.001$), respectively.

Discussion

Several studies have been conducted on the effectiveness of different rehabilitation strategies in patients with ALS. Due to the restrictive public health measures established as a response to the COVID-19 pandemic, a longitudinal study was conducted to assess the effect of the cessation of these therapies on the progression of ALS in patients who could not perform their weekly rehabilitation therapies onsite.

Previous studies have shown that disease-specific recommendations (general mobility, physical activity, stretching, and range of motion exercises) can benefit patient's functionality (Paganoni et al., 2015; Bello-Haas, 2018; Merico et al., 2018). Growing evidence shows that exercise-based therapies (especially aerobic exercise and resistance exercise of the unaffected muscles) might slow functional decay, although the neuroprotective mechanisms are still not well established, and can also help to adapt and improve functionality and lessen caregiver burden (de Almeida et al., 2012; Lisle and Tennison, 2015; Lunetta et al., 2016; Braga et al., 2018). Bulbar symptoms, which lead to a progressive loss of speech, phonation, and swallowing abilities (dysphagia and dysarthria), can also benefit from rehabilitation care

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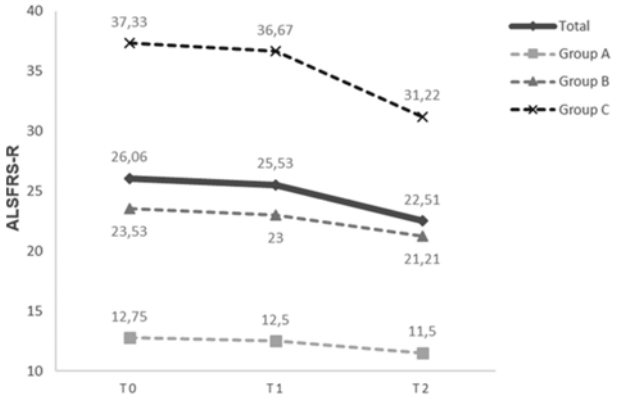

Fig. 1. ALSFRS-R values at each period (T0, T1, and T2). Total represents the mean values at each assessment, Group A — severe to total functional dependency patients at T0, Group B — moderate to severe functional dependency patients, and Group C — mild to moderate functional dependency patients.

Table 2. Mean and standard deviation values for ALSFRS-R and ALSFRS-R subscores slopes during each assessment period (T0–T1, T1–T2)

	T0–T1	T1–T2	*p*-value
ALSFRS-R	0.26 ± 0.38	1.36 ± 1.43	<0.001*
BS	0.16 ± 0.51	0.66 ± 0.87	0.009*
ULS	0.09 ± 0.59	0.72 ± 1.14	0.005*
LLS	0.25 ± 0.57	0.91 ± 1.12	0.004*
RS	0.22 ± 0.42	0.44 ± 0.88	0.182

BS, bulbar subscore; ULS, upper limbs subscore; RS, respiratory subscore.
*Statistically significant.

such as alternative communication strategies, training, and feeding and nutrition guidance (Leveque, 2006; Makkonen et al., 2018). Overall, there were significant differences in the rates of the decay, with a faster pattern during the T1–T2 (from 0.27 to 1.36 units/month on ALSFRS-R score) period when the rehabilitation routines were interrupted. Notably, the majority of the patients in this study presented a slow progression rate at the beginning, and the acceleration of the functional decline to a fast progression pattern was not related to the onset form, reflecting in both cases decreased functionality. It is essential to highlight that there were only 7 bulbar patients in the study, which represents a statistical limitation, although the ratio presented between bulbar/spinal patients is in agreement with previous literature (Hardiman et al., 2017).

The deterioration pattern in ALS is non-linear with early, medium, and late stages of the illness declining at different rates, and the ALSFRS-R slope and its domains follow this curvilinear progression (Gordon et al., 2010; Rooney et al., 2017; Ackrivo et al., 2019). This finding might be particularly worth noting considering the mean symptoms onset of the participants and the percentage of "slow progressors" at the beginning that presented a faster decline progression after the interruption of the rehabilitation treatment during lockdown. In this study, we found that the most functional patients (group C) at the beginning of the evaluation were the most prone to have an accelerated functional decline with the interruption, and therefore to experience the largest decline in function and independency, followed by the moderate dependent patients (group B), which also showed this tendency (despite not reaching the statistical significance). However, it was not verified among the severe patients (group A). The slope differences between the groups can be interpreted as separate groups of patients presenting at different stages of the disease rather than representing the progression from baseline. This reflects a change in the ALSFRS-R curve with a faster decline in the mild dependency group (scores from 32 to 48) and a preserved linearity tendency in the decline rate among severe patients (latter part of the curve). The results of this study reinforce the importance of rehabilitation in general, and physical therapy and speech therapy in particular, especially in mild and moderate dependent patients, where it can significantly contribute to slow the progression of the disease, minimizing the slope decay of ALSFRS-R. The interruption of rehabilitation treatment routines, forced by the lockdown, may have accelerated the functional decline in ALS patients' motor skills; this might be a consequence of lack of training during this lockdown. We hypothesize that therapy routines might minimize temporary shifts from slow to fast progressors, specially in patterns, considering the increase in functional decay (bulbar function, upper and lower limbs, and fatigue) since the faster decline in certain motor functions may stabilize after resumption of rehabilitation routines. This may also be implicated in patients who might consider to dropout rehabilitation routines, during their disease journey. In that case, they should be, in some way be encouraged to keep their supervised rehabilitation routines (either through the hospital, clinics, associations, home programs, and/ or caregivers training).

Reflecting on the moderate to severe patients, it is important to consider this small subgroup sample, and also to critically adapt the multidisciplinary rehabilitation goals to be more centered in preserving wellbeing, increasing participation, and minimizing loss of function derived complications such as deformities, loss of range of motion, respiratory and nutritional management, alternative communication strategies and controls, and symptoms management (Paganoni et al., 2015; Bello-Haas, 2018). These should be evaluated on a case-by-case basis, as many of parameters that ALSFRS-R scale evaluates do not present good sensitivity because they do not directly reflect the scale evaluation but can significantly impact the QoL of the patient and their carers.

Furthermore, the decay between T0–T1 and T1–T2 was significant in the bulbar, upper limbs, and lower limbs subdomains but not in the respiratory subdomain. This might be associated with the continuous respiratory management, which is highly supported when needed with mechanical ventilation, educational programs (on adherence and effective use), including home telemonitoring follow-up and assistance (Pinto et al., 2010; O'Brien et al., 2019). The fact that patients are confined at their homes may also generate fewer respiratory symptoms (like dyspnea) due to decreased mobility and metabolic demand (Pinto and de Carvalho, 2015). An overlap between the natural weakness caused by ALS and the deconditioning process caused by the lack of use and stimulation may have occurred in T1–T2 period, which favored the decay on bulbar and limb functionality as well an increase in symptoms of fatigue, with a higher FSS score in T2.

QoL decreased over time. Four specific domains (*Negative Emotions*, *Physical Symptoms*, *Bulbar Function,* and *Interactions with People and Environment*) contributed the most for this decay, followed by a lower *Self-perception* of QoL, contradicting previous studies that have reported independence of patient QoL vs. symptom progression related to the adjustment of expectations over time (Robbins et al., 2001; Chiò et al., 2004;

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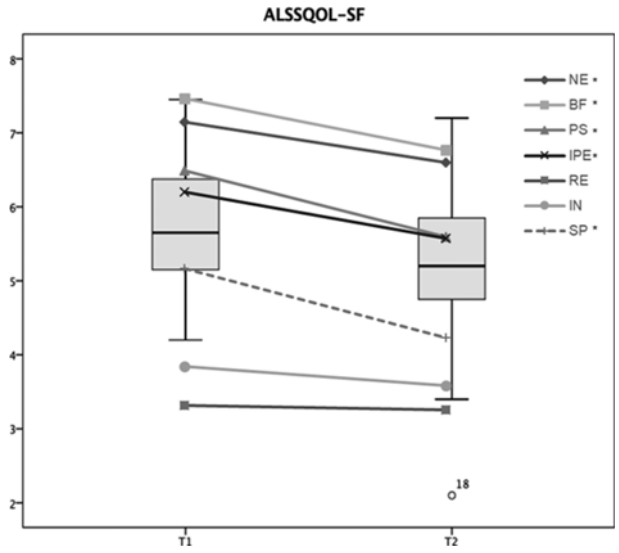

Fig. 2. ALSSQOL-SF total scores for T1 and T2 are reported in the boxplots. The lines represent the different domains. NE, negative emotions; BF, bulbar function; PS, physical symptoms; IPE, interactions with people and environment; RE, religiosity; IN, intimacy; and SP, self-perception. *Statistically significant.

Simmons, 2015). These results may be related to the acceleration of disease progression (between T0–T1 and T1–T2), with lower functionality in physical and bulbar function in particular impairing participation and performance in daily living activities and routines. In fact, patients with ALS have high equipment needs that can assist them to optimize their QoL (Londral et al., 2015; Connors et al., 2019), and the results support that patients with ALS benefit from early strategies to support and prepare functional decay, such as adaptive equipment designed to assist mobility, hygiene, comfort, and augmentative/alternative communication devices. Additional strategies include the education of patients and carers on symptoms management and energy-conservation, anticipating the next possible stage of the disease, whether it arrives or not. The *Interactions in People and Environment* decay was expected as it represents the social and environmental relationships that can be affected by the lockdown imposed to combat the pandemic. We hypothesized that a combination between the perception of loss, loss of functionality, and the lockdown itself might have contributed together to the decrease in QoL, especially considering the reduction in direct multidisciplinary support that patients and carers have experienced at this time.

Furthermore, the negative correlation between fatigue and the *Physical Symptoms* and *Negative Emotions* domains of ALSSQOL-SF concurs with other authors that highlight the experience of fatigue with worse motor function and NE (Vucic et al., 2007; Lou et al., 2010; Gibbons et al., 2013), reinforcing the importance of continuous multidisciplinary-care assessment and treatment of fatigue in ALS patients.

Symptom management is a major component of ALS care. Identifying and addressing problematic symptoms can minimize their effects on a person's function, health, and quality of life. This management can be enhanced by healthcare professionals using telehealth technologies in patient care and training and support of carers (Andrews et al., 2020; Helleman et al., 2020; Stegmann et al., 2020) throughout disease progression. These telehealth technologies can include multidisciplinary rehabilitation programs, nutrition, ventilation and pharmacology, brain–computer interfaces and eye-tracking, augmentative communication and environment control, virtual-reality, and mobile/computer applications that can connect patients to their multidisciplinary teams daily, providing alternative dynamic connecting tools. This pandemic presents an unexpected opportunity to recognize gaps and challenges in rehabilitation and speed up the development and implementation of patient-oriented technologies, with high value for both clinical practice and the improvement in quality of daily living among patients with ALS and their caregivers.

Some study limitations should be highlighted, including the sample size and subgroup analysis (with small bulbar representation $n < 10$). Additionally, although the relationship between functional loss and quality of life is unquestionable, the negative effects may be enhanced by social isolation itself and increased the perceived stress levels imposed by the lockdown, so they should be analyzed and interpreted carefully. It would be interesting to follow-up these patients after the lockdown and assess the impact of returning to rehabilitation routines on QoL and functionality slopes and progression patterns.

In conclusion, rehabilitation treatment routines in palliative care, such as physiotherapy and speech therapy, appear to mitigate the ALSFRS-R slope. A sudden dropout or prolonged interruption of these interdisciplinary rehabilitation routines may have accelerated the functional decline in certain ALS patients' motor skills (as measured by ALSFRS-R). And might have short-term effects (less than 2 months) such as increased fatigue, negative impact on QoL, poorer bulbar and limb function, with an increased decay in the ALSFRS-R subscores reflecting bulbar function, upper limb function , and lower limb funcion, but not in the respiratory subscore.

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References

Ackrivo J, Hansen-Flaschen J, Jones BL, *et al.* (2019) Classifying patients with amyotrophic lateral sclerosis by changes in FVC. A group-based trajectory analysis. *American Journal of Respiratory and Critical Care Medicine* **200**(12), 1513–1521.

Andersen PM, Abrahams S, Borasio GD, *et al.* (2012) EFNS guidelines on the clinical management of amyotrophic lateral sclerosis (MALS)–revised report of an EFNS task force. *European Journal of Neurology* **19**(3), 360–375.

Andrews JA, Berry JD, Baloh RH, *et al.* (2020) Amyotrophic lateral sclerosis care and research in the United States during the COVID-19 pandemic: Challenges and opportunities. *Muscle & Nerve* **62**(2), 182–186.

Bakker LA, Schröder CD, van Es MA, *et al.* (2017) Assessment of the factorial validity and reliability of the ALSFRS-R: A revision of its measurement model. *Journal of Neurology* **264**(7), 1413–1420.

Bello-Haas VD (2018) Physical therapy for individuals with amyotrophic lateral sclerosis: Current insights. *Degenerative Neurological and Neuromuscular Disease* **8**, 45–54.

Braga ACM, Pinto A, Pinto S, *et al.* (2018) The role of moderate aerobic exercise as determined by cardiopulmonary exercise testing in ALS. *Neurology Research International* **2018**, 10.

Chiò A, Gauthier A, Montuschi A, *et al.* (2004) A cross sectional study on determinants of quality of life in ALS. *Journal of Neurology, Neurosurgery, and Psychiatry* **75**(11), 1597–1601.

Chio A, Logroscino G, Traynor BJ, *et al.* (2013) Global epidemiology of amyotrophic lateral sclerosis: A systematic review of the published literature. *Neuroepidemiology* **41**(2), 118–130.

https://doi.org/10.1017/S1478951521000584 Published online by Cambridge University Press

Connors KA, Mahony LM and Morgan P (2019) Adaptive equipment use by people with motor neuron disease in Australia: A prospective, observational consecutive cohort study. *Disability and Rehabilitation Assistive Technology* **14**(1), 62–67.

de Almeida JP, Silvestre R, Pinto AC, *et al.* (2012) Exercise and amyotrophic lateral sclerosis. *Neurological Sciences* **33**(1), 9–15.

Felgoise SH, Feinberg R, Stephens HE, *et al.* (2018) Amyotrophic lateral sclerosis-specific quality of life-short form (ALSSQOL-SF): A brief, reliable, and valid version of the ALSSQOL-R. *Muscle Nerve* **58**(5), 646–654.

Gayoso MV, Domingues FS, Franca Junior MC, *et al.* (2020) Cross-cultural adaptation and validation for the Brazilian population of the instrument amyotrophic lateral sclerosis-specific quality of life-short form (ALSSQOL-SF). *Quality of Life Research* **29**(3), 805–813.

Gibbons CJ, Thornton EW and Young CA (2013) The patient experience of fatigue in motor neurone disease. *Frontiers in Psychology* **4**, 788.

Gordon PH (2013) Amyotrophic lateral sclerosis: An update for 2013 clinical features, pathophysiology, management and therapeutic trials. *Aging and Disease* **4**(5), 295–310.

Gordon PH, Miller RG and Moore DH (2004) ALSFRS-R. *Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders* **5**(Suppl 1), 90–93.

Gordon PH, Cheng B, Salachas F, *et al.* (2010) Progression in ALS is not linear but is curvilinear. *Journal of Neurology* **257**(10), 1713–1717.

Hardiman O, Al-Chalabi A, Chio A, *et al.* (2017) Amyotrophic lateral sclerosis.*Nature Reviews Disease Primers* **3**, 17071.

Helleman J, Kruitwagen ET, van den Berg LH, *et al.* (2020) The current use of telehealth in ALS care and the barriers to and facilitators of implementation: A systematic review. *Amyotrophic Lateral Sclerosis & Frontotemporal Degeneration* **21**(3–4), 167–182.

Hogden A, Foley G, Henderson RD, *et al.* (2017) Amyotrophic lateral sclerosis: Improving care with a multidisciplinary approach. *Journal of Multidisciplinary Healthcare* **10**, 205–215.

Kasarskis EJ, Dempsey-Hall L, Thompson MM, *et al.* (2005) Rating the severity of ALS by caregivers over the telephone using the ALSFRS-R. *Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders* **6**(1), 50–54.

Leveque N (2006) [Speech therapy guidelines in patients with amyotrophic lateral sclerosis]. *Revue Neurologique (Paris)* **162**(Spec No 2), 4s269–4s272.

Lisle S and Tennison M (2015) Amyotrophic lateral sclerosis: The role of exercise. *Current Sports Medicine Reports* **14**(1), 45–46.

Londral A, Pinto A, Pinto S, *et al.* (2015) Quality of life in amyotrophic lateral sclerosis patients and caregivers: Impact of assistive communication from early stages. *Muscle Nerve* **52**(6), 933–941.

Lou JS (2012) Techniques in assessing fatigue in neuromuscular diseases. *Physical Medicine and Rehabilitation Clinics of North America* **23**(1), 11–22, ix.

Lou JS, Weiss MD and Carter GT (2010) Assessment and management of fatigue in neuromuscular disease. *American Journal of Hospice & Palliative Care* **27**(2), 145–157.

Lunetta C, Lizio A, Sansone VA, *et al.* (2016) Strictly monitored exercise programs reduce motor deterioration in ALS: Preliminary results of a randomized controlled trial. *Journal of Neurology* **263**(1), 52–60.

Maier A, Holm T, Wicks P, *et al.* (2012) Online assessment of ALS Functional Rating Scale compares well to in-clinic evaluation: A prospective trial. *Amyotrophic Lateral Sclerosis* **13**(2), 210–216.

Makkonen T, Ruottinen H, Puhto R, *et al.* (2018) Speech deterioration in amyotrophic lateral sclerosis (ALS) after manifestation of bulbar symptoms. *International Journal of Language & Communication Disorders* **53**(2), 385–392.

Merico A, Cavinato M, Gregorio C, *et al.* (2018) Effects of combined endurance and resistance training in amyotrophic lateral sclerosis: A pilot, randomized, controlled study. *European Journal of Translational Myology* **28** (1), 132–140.

Ng L, Khan F, Young C, *et al.* (2017) Symptomatic treatments for amyotrophic lateral sclerosis/motor neuron disease. *Cochrane Database of Systematic Reviews* **1**, CD011776.

O'Brien D, Stavroulakis T, Baxter S, *et al.* (2019) The optimisation of noninvasive ventilation in amyotrophic lateral sclerosis: A systematic review. *European Respiratory Journal* **54**, 3.

Paganoni S, Karam C, Joyce N, *et al.* (2015) Comprehensive rehabilitative care across the spectrum of amyotrophic lateral sclerosis. *NeuroRehabilitation* **37**(1), 53–68.

Paipa AJ, Povedano M, Barcelo A, *et al.* (2019) Survival benefit of multidisciplinary care in amyotrophic lateral sclerosis in Spain: Association with noninvasive mechanical ventilation. *Journal of Multidisciplinary Healthcare* **12**, 465–470.

Pfohl SR, Kim RB, Coan GS, *et al.* (2018) Unraveling the complexity of amyotrophic lateral sclerosis survival prediction. *Frontiers in Neuroinformatics* **12**, 36.

Pinto S and de Carvalho M (2015) The R of ALSFRS-R: Does it really mirror functional respiratory involvement in amyotrophic lateral sclerosis? *Amyotrophic Lateral Sclerosis & Frontotemporal Degeneration* **16**(1–2), 120–123.

Pinto A, Almeida JP, Pinto S, *et al.* (2010) Home telemonitoring of noninvasive ventilation decreases healthcare utilisation in a prospective controlled trial of patients with amyotrophic lateral sclerosis. *Journal of Neurology, Neurosurgery, and Psychiatry* **81**(11), 1238–1242.

Proudfoot M, Jones A, Talbot K, *et al.* (2016) The ALSFRS as an outcome measure in therapeutic trials and its relationship to symptom onset. *Amyotrophic Lateral Sclerosis & Frontotemporal Degeneration* **17**(5–6), 414–425.

Robbins RA, Simmons Z, Bremer BA, *et al.* (2001) Quality of life in ALS is maintained as physical function declines. *Neurology* **56**(4), 442–444.

Rooney J, Byrne S, Heverin M, *et al.* (2015) A multidisciplinary clinic approach improves survival in ALS: A comparative study of ALS in Ireland and northern Ireland. *Journal of Neurology, Neurosurgery, and Psychiatry* **86**(5), 496–501.

Rooney J, Burke T, Vajda A, *et al.* (2017) What does the ALSFRS-R really measure? A longitudinal and survival analysis of functional dimension subscores in amyotrophic lateral sclerosis. *Journal of Neurology, Neurosurgery, and Psychiatry* **88**(5), 381–385.

Simmons Z (2015) Patient-perceived outcomes and quality of life in ALS. *Neurotherapeutics* **12**(2), 394–402.

Stegmann GM, Hahn S, Liss J, *et al.* (2020) Early detection and tracking of bulbar changes in ALS via frequent and remote speech analysis. *npj Digital Medicine* **3**(1), 132.

Van den Berg JP, Kalmijn S, Lindeman E, *et al.* (2005) Multidisciplinary ALS care improves quality of life in patients with ALS. *Neurology* **65**(8), 1264–1267.

Vucic S, Krishnan AV and Kiernan MC (2007) Fatigue and activity dependent changes in axonal excitability in amyotrophic lateral sclerosis. *Journal of Neurology, Neurosurgery, and Psychiatry* **78**(11), 1202–1208.

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