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Research Article

Amyotrophic Lateral Sclerosis: The Relationship Between Percentage of Body Weight Change and the Amyotrophic Lateral Sclerosis Functional Rating Scale - Revised. A Pilot Study

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Abstract

Objective: To explore the relationship between body weight change and functional decline using the ALSFRS-R.

Methods: A retrospective analysis of 68 veterans with ALS was conducted. We used a Pearson's Product Momentum Correlation to examine the relationship between percentage of body weight change and ALSFRS-R total score change from initial visit to three, six, and nine months of follow-up.

Results: The sample was 95.6% male with a mean age of 68.2 years. Over nine months, 38.2% of individuals had a feeding tube placed and 30.2% died. Mean body weight and mean BMI increased from initial visit (82.7 kg and 26.2 kg/m^2) to nine months (86.7 kg and 27.4 kg/m^2), but not significantly. No deaths occurred in obese individuals (n = 11), while 66.7% of deaths (11 of 19) occurred in individuals with an initial underweight or normal BMI. There was no significant relationship between percentage of body weight change and change in the ALSFRS-R total score from baseline to three months (p = 0.31), six months (p = 0.36), and nine months (p = 0.25).

Conclusions: Future research should include multicenter, prospective studies of veterans with ALS and investigate a potential survival advantage of obesity.

Keywords: *Nutrition; Amyotrophic Lateral Sclerosis; Weight; Body Mass Index*

Abbreviations

ALS: Amyotrophic Lateral Sclerosis; BMI: Body Mass Index; UBW: Usual Body Weight; ALSFRS-R: Amyotrophic Lateral Sclerosis Functional Rating Scale – Revised; VAMC: Minneapolis Veterans Affairs Medical Center; EMR: Electronic Medical Record; SPSS: Statistical Package for Social Sciences

Introduction

United States military veterans have a 60% greater risk of developing amyotrophic lateral sclerosis (ALS) than the general population [1,2]. The highest rates exist in veterans of the Gulf War, who are twice as likely to develop ALS when compared to veterans not deployed to the Gulf [3,4]. Potential risk factors for disease development in this population include environmental factors such as chemical exposure, traumatic activity (severe head, neck, or back injury), or intense physical activity [4-6].

Malnutrition is a negative prognostic indicator present in 16-55% of individuals with ALS, depending on the parameters measured [7,8]. When a body mass index (BMI) less than 18.5 kg/m^2 is used as the cut off for malnutrition, 16 to 19% of individuals with ALS are

malnourished [9,10]. Using a BMI less than 20 kg/m^2, the prevalence is as high as 55% [8]. Malnutrition is present in 25% of individuals when an unintentional weight loss greater than 10% of usual body weight (UBW) is established as the threshold [8,11]. Weight loss, dehydration and malnutrition may exacerbate muscle weakness and hasten respiratory decline [12,13]. Malnourished individuals with ALS have shorter survival ($p < 0.0001$) and are at a 7.7 fold increased mortality risk compared to those who are not malnourished [9]. At diagnosis, a 5% or greater weight loss from UBW is associated with a twofold-increased risk of shorter survival [14]. Consequently, each 5% decrease in UBW is associated with a 34% increased risk of shorter survival when compared to those whose weight loss is less than 5% of UBW ($p < 0.0001$) [14]. Similarly, a rapid decline in BMI prior to diagnosis leads to shorter survival ($p < 0.0001$) [15]. Individuals with ALS may implement nutrition interventions such as a high calorie diet, texture modification of foods, and placement of a feeding tube to lessen malnutrition risk [16,17].

The ALS Functional Rating Scale – Revised (ALSFRS-R) is a useful survival predictor in ALS. The ALSFRS-R is a validated 12-item functional inventory tool used to assess disease progression [18]. The score is divided into four domains which include bulbar function (speech, salivation, swallowing), fine motor tasks (handwriting, cutting food and handling utensils, dressing and hygiene), gross motor tasks (walking, bed mobility, climbing stairs) and respiratory function (dyspnea, orthopnea, respiratory insufficiency) [19,20]. The total score ranges from 0 (maximum disability) to 48 (normal) points [20]. A lower ALSFRS-R score at the time of diagnosis is associated with shorter survival ($p < 0.05$) [20,21]. Individuals with a BMI near 30 kg/m^2 have the slowest rate of ALSFRS-R decline when compared to individuals with a BMI < 30 kg/m^2 [22]. Weight loss is associated with a significantly worse ALSFRS-R score at two years follow-up when compared to individuals that did not lose > 5% of their UBW ($p < 0.05$) [17].

We sought to investigate the relationship between percentage of body weight change and functional decline (as measured by the ALSFRS-R) from initial visit through the nine-month follow-up for veterans that initiated ALS specialty care at the Minneapolis Veterans Affairs Medical Center (VAMC). Our hypothesis was that there would be a direct relationship between percentage of weight loss and functional decline. There is growing evidence that maintenance of a higher BMI may alter disease progression and lengthen survival, and that weight loss prior to diagnosis and malnutrition during the disease course shortens survival [7,9,14,15,17,22-24]. This pilot study also provides the first steps towards developing a nutrition research base in United States military veterans with ALS.

Material and Methods

This was a retrospective observational study that used the electronic medical record (EMR) of veterans to collect data. It was limited to veterans referred to the VAMC for specialty ALS care between January 1, 2010 and October 1, 2012. The EMR of 108 veterans were reviewed for study inclusion. Those that did not initiate specialty care between the designated dates, did not have the diagnosis of ALS, or were ≥ 89 years of age were excluded. Only EMRs that had the ALSFRS-R documented were used. For individuals that died before the nine-month follow-up, statistical analyses were completed for the intervals with which they were living. If included cases were missing data, the available data were used for analysis. Age was recorded as the age on the date of the initial appointment. Data must have been present in the EMR within ± 30 days of the intervals of three, six, and nine months to be used.

The number of days from initial visit to death was extracted from the EMR. Body weight was obtained at clinic check-in using a standing or bed scale at each visit, and height was self-reported at the initial visit. BMI was calculated within the EMR. The physician or nurse practitioner completed the ALSFRS-R score at each clinic visit. Percentage of body weight change and change in ALSFRS-R score were calculated as the difference between each parameter at the initial visit and at three, six, and nine-month follow-up visits. The ALSFRS-R total score is the composite score of the 12 categories of the ALSFRS-R with the highest possible score of 48, indicating full function and lower scores representing functional loss [20]. Each subcomponent is rated on a scale of 0 to 4.

The study was approved by the Rutgers Health Sciences Institutional Review Board and the Research and Development Board at the Minneapolis Veterans Affairs Medical Center in Minneapolis, Minnesota. Statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) Version 21.0 [25]. A priori alpha was set at ≤ 0.05. Paired t-tests were used to analyze mean changes in variables

between time intervals. Pearson's product moment correlations were used to determine if there were relationships between body weight change and change in ALSFRS-R total score from initial visit to three, six, and nine-month follow-up appointments.

Results

Sixty-nine individuals (63.9%) met inclusion criteria. One patient was removed from data analysis because of functional limitations of an amputation that prevented accurate scoring of the ALSFRS-R. The mean age of the individuals was 68.2 years (SD = 10.6, range 43.0 - 87.0), and 95.6% (n = 65) were male. Thirty-eight percent (n = 26, 38.2%) of individuals had a feeding tube placed within the nine-month study timeframe. At the initial visit, 13.2% (n = 9) of individuals had a feeding tube in place, compared to 30.5% (n = 18) of 59 individuals, 36.0% (n = 18) of 50 individuals, and 41.9% (n = 18) of 43 individuals at three, six, and nine months respectively (Table 1). Nine individuals with feeding tubes died within the nine months of the study, four of whom died within three months of having their feeding tube placed. Thirty percent (n = 19, 30.2%) of individuals died within nine months; 9.1% (n = 6) died within three months and 18.8% (n = 12) died within six months (Table 1).

Patient Clinical Characteristics	**Total Number of Individuals with Available Data (n)**	**(n, %)**
Feeding Tube at Initial	68	9 (13.2%)
Feeding Tube at 3 Months	59	18 (30.5%)
Feeding Tube at 6 Months	50	18 (36.0%)
Feeding Tube at 9 Months	43	18 (41.9%)
Life Status	**Total Number of Individuals with Available Data (n)**	**(n, %)**
Deceased within 3 Months	66	6 (9.1%)
Deceased within 6 Months	64	12 (18.8%)
Deceased within 9 Months	63	19 (30.2%)

Table 1: *Feeding Tube and Life Status of Individuals with ALS.*

[A] *The percentage of individuals with a feeding tube is based on the number of individuals with a feeding tube at each interval divided by the total number of individuals with these data available at each interval (those missed at follow-up or deceased were excluded).*

[B] *The percentage of deceased individuals is a cumulative percentage of the total number of deaths divided by the total number of individuals with these data available at each interval (those missed at follow-up were excluded)*

The mean body weight of the sample increased 4 kg from initial visit (n = 68, 82.3 kg) to nine months (n = 26, 86.7 kg). Similarly, the mean BMI increased over time (n=67, 26.2 kg/m^2) to nine months (n = 26, 27.4 kg/m^2) (Table 2). During the study time frame, no deaths occurred in individuals that were obese at the initial visit (n = 11), while 66.7% of deaths (11 of 19) occurred in individuals with a BMI in the underweight or normal weight categories at their initial visit. Obese individuals accounted for a larger percentage of surviving individuals from initial visit (n = 11, 16.4%) to nine months (n = 7, 26.9%) (Table 2). The mean percentage of body weight change among surviving individuals from the initial visit to three, six and nine months was -2.5% (n = 42), -2.6% (n = 40), and -2.9% (n = 26), respectively (Table 3).

Patient Characteristic	Total Number of Individuals with Available Data (n)[A]		Mean	Standard Deviation	Median		Range	
Body Weight Initial (kg)	68		82.7	15.3	79.8		50.9 - 129.1	
Body Weight 3 Months (kg)	42		82.7	16.4	77.1		53.2 - 131.4	
Body Weight 6 Months (kg)	40		82.5	17.3	76.1		64.1 - 135.0	
Body Weight 9 Months (kg)	26		86.7	17.2	82.7		62.7 - 132.7	
BMI Category[B]								
BMI Initial	67		26.2	4.8	25.3		15.7 - 42.0	
BMI 3 Months	41		26.3	4.9	24.7		18.4 - 38.2	
BMI 6 Months	40		26.0	5.2	24.5		19.7 - 44.0	
BMI 9 Months	26		27.4	5.8	25.6		19.0 - 43.2	
Body Mass Index (BMI) Category	**Initial Visit (n = 67)**		**3 Months (n = 41)**		**6 Months (n = 40)**		**9 Months (n = 26)**	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Underweight (BMI <18.5)	1	1.5	1	2.4	0	0.0	0	0.0
Normal Weight (BMI 18.5 - 24.99)	31	46.3	21	51.2	22	55.0	12	46.2
Overweight (BMI ≥25)	24	35.8	10	24.4	10	25.0	7	26.9
Obese (BMI ≥30)	11*	16.4	9	22.0	8	20.0	7	26.9

Table 2: *Body Weight, Body Mass Index (BMI) and BMI Category of Individuals with ALS at Initial, Three, Six, and Nine Months Visits.*

[A] Total number of individuals with measured weight and BMI at each interval (those missed at follow - up or deceased were excluded).

[B] BMI Categories: Underweight (BMI < 18.5), Normal Weight (BMI 18.5 - 24.99), Overweight (BMI ≥ 25), Obese (BMI ≥ 30)

**None of the 11 individuals in the obese category at the initial visit died during the nine months of this study, although two individuals did lose weight taking them out of the obese BMI category and two others were missed at follow - up*

Table 3 displays the mean ALSFRS-R total scores and change in ALSFRS-R scores at each time interval. None of the 16 individuals with an ALSFRS-R total score > 39 at the initial visit died during the nine months of the study. All ALSFRS-R subcomponent scores decreased from initial visit to nine months. There were no significant relationships between weight change and ALSFRS-R total score change between each of the time intervals.

Patient Characteristic	Total Number of Individuals with Available Data (n)	Mean	Standard Deviation	Median	Range
Percentage of Body Weight Change					
Initial to 3 Months	42	-2.5%	4.7	3.0	-7.3 to 12.9
Initial to 6 Months	40	-2.6%	5.3	2.6	-11.2 to 11.9
Initial to 9 Months	26	-2.9%	8.3	2.2	-11.1 to 21.6
ALSFRS-R Total Score					
Initial	66	32.8	8.8	35.0	11.0 to 48.0
3 Months	41	30.0	9.4	31.0	8.0 to 48.0

6 Months	36	29.8	9.4	30.0	8.0 to 48.0
9 Months	27	28.5	9.0	31.0	8.0 to 42.0
ALSFRS-R Total Score Change					
Initial to 3 Months	41	-2.7	3.2	2.0	-4.0 to 11.0
Initial to 6 Months	36	-4.6	5.7	4.0	-8.0 to 23.0
Initial to 9 Months	27	-6.9	6.4	6.0	-2.0 to 28.0

Table 3: *Percentage of Body Weight Change, ALSFRS-R Total Score, and ALSFRS-R Total Score Change for Individuals with ALS Over Time.*

Note: The difference between the number of individuals with available data on body weight and the number of individuals with ALSFRS-R is the result of individuals that declined to have their weight obtained at appointments or the failure of staff to have the patient's weight obtained. The range for ALSFRS-R total score is 48 to 0.

Discussion

The purpose of this study was to examine if a relationship existed between percentage of body weight change and functional decline as measured by the ALSFRS-R score. Our hypothesis was not supported by the study findings; there was no relationship found between percentage of body weight change and total score change in ALSFRS-R. A post hoc power analysis identified the study to be severely underpowered. Based on an α=0.05 and β=0.8, and the effect size observed in this study, a total sample of 1578 subjects would have been needed. Thus, the lack of significant findings may be attributed to the effect size being very small, and even if a larger sample was obtained the finding may not be clinically meaningful. Furthermore, obtaining a sample this large among the population with ALS would be difficult.

However, this pilot study develops a nutrition research base in United States military veterans with ALS. This is the first known investigation of ALS disease markers of body weight, BMI, feeding tube placement, and ALSFRS-R in United States military veterans with ALS. The establishment of ALS as a military service connected disorder in 2008 by the United States Department of Veterans Affairs, presumes that ALS development in military veterans was aggravated by their military service creating the need for research that determines how military veterans with ALS compare to the non-veteran population with ALS [5].

Almost 40% of individuals in this study had a feeding tube placed for the immediate or eventual need of enteral nutrition. This percentage is on the higher end of that reported in national averages of individuals with ALS in the United States in which 13.0 - 40.0% of individuals have feeding tubes placed [26,27]. Zhang., *et al.* found that individuals with motor neuron disease that were routinely followed by a registered dietitian, speech language pathologist, or gastroenterologist were significantly more likely to have a feeding tube placed than individuals who did not receive specialized nutrition care (56.0% versus 24.0%, p = 0.011) [28]. A registered dietitian and a speech language pathologist addressed the potential need for a feeding tube with all individuals in this study, which may explain this higher percentage of feeding tube placement.

Over 30% of individuals died by the ninth month of this study, or almost 4.8 months from their initial visit. This is more rapid than prior studies. Chio., *et al*. reported in their study that the median survival from onset of symptoms to death was 20 to 48 months [29]. The shorter survival experienced in our study participants may be related to their older age at the initial visit (mean age of 68.2 years) as compared to prior studies, and the potential delay from the time of symptom onset and diagnosis to referral to the VAMC for specialty ALS care [17,22,24,30-35].

Over the nine months of this study, the mean body weight and the mean BMI of the sample increased. This change was reflective of no deaths occurring in individuals that were obese at their initial visit, while 67% of deaths occurred in individuals in the under or normal weight categories at their initial visit. The greater mean weight and mean BMI at nine months reflects the survival of individuals who started at a higher body weight and BMI. However, the surviving individuals did lose weight over time with a -2.5% to -2.9% mean per-

centage of body weight loss at each 3-month interval. Previous research has also found a survival advantage for individuals with ALS that are obese [14,24]. Marin., *et al*. found that individuals who maintained their weight in the overweight or obese BMI categories throughout disease progression had a reduced risk of death (RR 0.71 and 0.36, respectively) when compared to individuals that maintained a normal BMI [14]. Paganoni., *et al.* found similar results, with the longest survival in individuals with a BMI between 30 - 35 kg/m^2 ($p = 0.001$) when compared to individuals with BMI < 30 or > 35 [24].

Consistent with ALS disease progression related functional decline the mean ALSFRS-R total score declined from 32.8 at the initial visit to 28.5 at nine months. Kollewe., et al. found that individuals with an ALSFRS-R total score < 39 at their initial visit had a median survival of 31 months shorter than individuals with a score > 39 ($p < 0.01$) [35]. None of the 16 individuals with an ALSFRS-R total score > 39 at the initial visit died within the nine months of this study.

The small sample size with declining numbers at each interval through nine-months of follow-up is a study limitation. Inconsistency in weight measurements (individuals may have been weighed with shoes on or off, different clothing or orthotic devices, varying scales, etc.), and self-reported heights introduce sources of possible error. Initiation of enteral nutrition was not monitored, and feeding tube placement could have been for the eventual versus immediate need for this support. Imprecise intervals of the number of days between appointments, and individuals missed at follow-up or not returning for follow-up appointments are additional study limitations. The study did not control for form of disease onset or co-morbid conditions that may have impacted collected variables.

Conclusion

We demonstrated that veterans with ALS lose weight, have a decline in functional ability (as measured by the ALSFRS-R) over the course of the disease and consistent with prior research, obese individuals with ALS have a potential survival advantage [14,23,24,33-35]. This study, and an increasing body of literature, reinforces the likely importance of weight maintenance or gain for a survival benefit for individuals with ALS [14,17,22,23,34]. The results of this study indicate that all possible interventions to maintain weight, or potentially gain weight, should be taken as a means of lengthening survival. Future research in United States military veterans with ALS should be designed as larger, multicenter, prospective studies that follow individuals pre-morbid to death while controlling for form of disease onset. Prospective studies of the effectiveness of nutrition interventions to reduce malnutrition risk should be explored [16,17].

Disclosure of Interests

No financial or conflict of interests to disclose for all authors.

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Bibliograhy

1. Weisskopf MG., *et al*. "Prospective study of military service and mortality from ALS". *Neurology* 64.1 (2005): 32-37.
2. Weisskopf MG., *et al*. "Prospective study of chemical exposures and amyotrophic lateral sclerosis". *Journal of Neurology, Neurosurgery, and Psychiatry* 80.5 (2009): 558-561.
3. Horner RD., *et al*. "Occurrence of amyotrophic lateral sclerosis among Gulf War veterans". *Neurology* 61.6 (2003): 742-749.
4. Haley RW. "Excess incidence of ALS in young Gulf War veterans". *Neurology* 61.6 (2003): 750-756.
5. "ALS in the Military: Unexpected Consequences of Military Service" (2013): 1-10.
6. Strickland D., *et al*. "Physical activity, trauma, and ALS: a case-control study". *Acta Neurologica Scandinavica* 94.1 (1996): 45-50.

7. Piquet MA. "Nutritional approach for patients with amyotrophic lateral sclerosis". *Revue Neurologique* 162.2 (2006): 4S177-4S187.

8. Mazzini L., *et al*. "Percutaneous endoscopic gastrostomy and enteral nutrition in amyotrophic lateral sclerosis". *Journal of Neurology* 242.10 (1995): 695-698.

9. Desport JC., *et al*. "Nutritional status is a prognostic factor for survival in ALS patients". *Neurology* 53.5 (1999): 1059-1063.

10. Rio A., *et al*. "Nutritional factors associated with survival following enteral tube feeding in patients with motor neurone disease". *Journal of Human Nutrition and Dietetics* 23.4 (2010): 408-415.

11. Slowie LA., *et al*. "Nutritional considerations in the management of patients with amyotrophic lateral sclerosis (ALS)". *Journal of the American Dietetic Association* 83.1 (1983): 44-47.

12. Katzberg HD and Benatar M. "Enteral tube feeding for amyotrophic lateral sclerosis/motor neuron disease". *Cochrane Database of Systematic Reviews* 1 (2011): CD004030.

13. Desport JC., *et al*. "Nutritional assessment and survival in ALS patients". *Amyotrophic Lateral sclerosis and Other Motor Neuron Disorders* 1.2 (2000): 91-96.

14. Marin B., *et al*. "Alteration of nutritional status at diagnosis is a prognostic factor for survival of amyotrophic lateral sclerosis patients". *Journal of Neurology, Neurosurgery, and Psychiatry* 82.6 (2011): 628-634.

15. Shimizu T., *et al*. "Reduction rate of body mass index predicts prognosis for survival in amyotrophic lateral sclerosis: a multicenter study in Japan". *Amyotrophic Lateral Sclerosis* 13.4 (2012): 363-366.

16. Greenwood DI. "Nutrition Management of Amyotrophic Lateral Sclerosis". *Nutrition in Clinical Practice* 28.3 (2013): 392-399.

17. Korner S., *et al*. "Weight loss, dysphagia and supplement intake in patients with amyotrophic lateral sclerosis (ALS): impact on quality of life and therapeutic options". *BMC Neurology* 13 (2013): 84.

18. Kaufmann P., *et al*. "The ALSFRS-R predicts survival time in an ALS clinic population". *Neurology* 64.1 (2005): 38-43.

19. "The Amyotrophic Lateral Sclerosis Functional Rating Scale. Assessment of activities of daily living in patients with amyotrophic lateral sclerosis. The ALS CNTF treatment study (ACTS) phase I-II Study Group". *Archives of Neurology* 53.2 (1996): 141-147.

20. Cedarbaum JM., *et al*. "The ALSFRS-R: a revised ALS functional rating scale that incorporates assessments of respiratory function. BDNF ALS Study Group (Phase III)". *Journal of the Neurological Sciences* 169.1-2 (1999): 13-21.

21. Liu XX., *et al*. "Revised amyotrophic lateral sclerosis functional rating scale at time of diagnosis predicts survival time in amyotrophic lateral sclerosis". *Zhonghua Yi Xue Za Zhi* 89.35 (2009): 2472-2475.

22. Reich-Slotky R., *et al*. "Body mass index (BMI) as predictor of ALSFRS-R score decline in ALS patients". *Amyotrophic Lateral Sclerosis and Frontotemporal Degeneration* 14.3 (2013): 212-216.

23. Limousin N., *et al*. "Malnutrition at the time of diagnosis is associated with a shorter disease duration in ALS". *Journal of the Neurological Sciences* 297.1-2 (2010): 36-39.

24. Paganoni S., *et al*. "Body mass index, not dyslipidemia, is an independent predictor of survival in amyotrophic lateral sclerosis". *Muscle Nerve* 44.1 (2011): 20-24.

25. Corp. I. IBM SPSS Statistics for Windows. 21.0 ed Released (2012).

26. Bradley WG., *et al*. "Changes in the management of ALS since the publication of the AAN ALS practice parameter 1999". *Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders* 5.4 (2004): 240-244.

27. Lechtzin N., *et al*. "Hospitalization in amyotrophic lateral sclerosis: causes, costs, and outcomes". *Neurology* 56.6 (2001): 753-757.

28. Zhang L., *et al*. "Nutritional support teams increase percutaneous endoscopic gastrostomy uptake in motor neuron disease". *World Journal of Gastroenterology* 18.44 (2012): 6461-6467.

29. Chio A., *et al*. "Prognostic factors in ALS: A critical review". Amyotrophic Lateral Sclerosis 10.5-6 (2009): 310-323.

30. Testa D., *et al*. "Survival of 793 patients with amyotrophic lateral sclerosis diagnosed over a 28-year period". *Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders* 5.4 (2004): 208-212.

31. Forbes RB., *et al*. "The epidemiology of amyotrophic lateral sclerosis (ALS/MND) in people aged 80 or over". *Age and Ageing* 33.2 (2004): 131-134.

32. Traynor BJ., *et al*. "Effect of a multidisciplinary amyotrophic lateral sclerosis (ALS) clinic on ALS survival: a population based study, 1996-2000". *Journal of Neurology, Neurosurgery, and Psychiatry* 74.9 (2003): 1258-1261.

33. Clavelou P., *et al*. "Rates of progression of weight and forced vital capacity as relevant measurement to adapt amyotrophic lateral sclerosis management for patient Result of a French multicentre cohort survey". *Journal of the Neurological Sciences* 331.1-2 (2013): 126-131.

34. Jawaid A., *et al*. "A decrease in body mass index is associated with faster progression of motor symptoms and shorter survival in ALS". *Amyotrophic Lateral Sclerosis* 11.6 (2010): 542-548.

35. Kollewe K., *et al*. "ALSFRS-R score and its ratio: a useful predictor for ALS-progression". *Journal of the Neurological Sciences* 275.1-2 (2008): 69-73.

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