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# Factors negatively affecting falling in patients with neuromuscular diseases: a prospective study

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## Research Report

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**Purpose:** The aims of this study were to compare the muscle strength, mobility level and quality of life in faller and non-faller patients with neuromuscular diseases and to determine the correlation of these parameters with falling frequency. **Material and methods:** Eighty patients (49: faller, 31: non-faller) with various neuromuscular diseases, who applied to a neurological rehabilitation outpatient clinic, were included to this prospective study. **Results:** There was a significant difference in the health related quality of life, particularly in the 'social isolation' and 'physical activity' parameters and in the isolated hip flexors, knee extensors and ankle dorsiflexors (right and left) muscle strength, without any significant difference between total lower extremity muscle strength results, of the subjects in the faller and non-faller groups ( $p < 0.05$ ). Falling frequency was found to be correlated with fear of falling ( $r = 0.437$ ), both right and left knee extensors muscle strength ( $r = -0.388$  ( $p < 0.05$ ) and  $r = -0.419$  ( $p < 0.05$ ), respectively). **Conclusion:** Although the hip flexors, knee extensors and ankle dorsiflexors muscle strength results were lower in the faller subjects, only the knee extensors muscle strength was found to be an important factor affecting falling frequency in patients with neuromuscular diseases.

**Key words:** Neuromuscular diseases, Falling, Risk factors.

## Nöromusküler hastalarda düşmeyi olumsuz yönde etkileyen faktörler: prospektif çalışma

**Amaç:** Bu çalışma düşen ve düşmeyen nöromusküler hastalarda kas kuvveti, mobilite düzeyi ve yaşam kalitesinin karşılaştırılması ve bu parametrelerin düşme frekansı ile korelasyonunun belirlenmesi amacıyla planlandı. **Gereç ve yöntem:** Bu çalışmaya nörolojik rehabilitasyon kliniğine başvuran çeşitli nöromusküler hastalık tanısı ile izlenen 80 hasta (49: düşen, 31: düşmeyen) dahil edildi. **Sonuçlar:** Düşen ve düşmeyen hastalar arasında sağlıklı ilgili yaşam kalitesi, özellikle 'sosyal izolasyon' ve 'fiziksel aktivite' parametreleri ve total alt ekstremitte kas kuvvetleri arasında önemli farklılık olmaksızın, izole kalça fleksörleri, diz ekstansörleri ve ayak bileği dorsifleksörleri (sağ ve sol) kas kuvvetleri açısından anlamlı fark bulundu ( $p < 0.05$ ). Hastaların düşme sıklığı ve düşme yeri ( $r = 0.437$ ), sağ ve sol diz ekstansör kas kuvveti arasında anlamlı bir korelasyon saptandı (sırasıyla  $r = -0.388$  ( $p < 0.05$ ) ve  $r = -0.419$  ( $p < 0.05$ )). **Tartışma:** Düşen hastaların kalça fleksör, diz ekstansör ve ayak bileği dorsifleksör kas kuvvetleri düşmeyen hastalara göre daha düşük bulunmasına rağmen, sadece diz ekstansör kas kuvveti düşmeyi olumsuz yönde etkileyen önemli bir faktör olarak bulundu.

**Anahtar kelimeler:** Nöromusküler hastalıklar, Düşme, Risk faktörleri.

Falls result from a complex interaction of intrinsic (patient-related) and extrinsic (environment-related) risk factors.<sup>1,2</sup> The intrinsic risk factors mainly include age, disease duration, previous falls, fear of falling, psychoactive/antihypertensive medicines, polypharmacy, muscle weakness, decreased mobility level,<sup>3-7</sup> while the extrinsic risk factors comprise of various indoor and outdoor environmental hazards.<sup>8</sup>

Falls are among the primary causes of morbidity in the elderly population. Approximately 30% of the community-living people fall at least once a year,<sup>9,10</sup> leading to serious injuries such as bone fractures, distortions and dislocations, and head injuries,<sup>11,12</sup> as well as fear of falling and reducing activities due to fear of falling.<sup>13</sup> Similarly, falling is the most common complication in patients with various neurological disorders such as Stroke and Parkinson's disease. Approximately 37% of the patients experience at least one fall and 18% two or more falls after a stroke.<sup>14</sup> Fall related injuries, mainly hip fractures due to the presence of hemi- osteoporosis, occur in 13-29% of the patients with stroke.<sup>14,15</sup> The fall rate was shown to be approximately 46%, in a 3-month follow up, of patients with Parkinson's disease in a meta-analysis study.<sup>16</sup> In a study of Wielinski et al considering the fractures occurred in Parkinson's diseased patients, it was found that 27.8% of all fractures were belong to the hip and pelvis followed by the trunk with a rate of 21.4%.<sup>17</sup>

Falls have not been examined extensively in patients with neuromuscular disorders (NMD). Only Pieterse et al have investigated the falls in patients with various groups of NMD.<sup>18</sup> This previous study concluded that falling is more often in patients with NMD when comparing to healthy people. The falls were accompanied by decrease in activities and fear of falling in this group of patients who had fallen. Similarly, the findings of another study including specifically the patients with myotonic dystrophy type 1 found that the patients were more likely to fall and stumble than the healthy control group. Furthermore, it was found that the faller patients have a lower mobility score, slower gait speed and higher depression

scores than the non-faller patients.<sup>19</sup>

In the light of the previous studies, it can be said that there are numerous patient and environment related factors negatively affecting falling in patients with NMD. Falls may lead to various physical (i.e. laceration, sprain, dislocation, fractures, concussion) and psychological (i.e. fear of falling, activity restriction, reduced quality of life, depression) destructions as such in other neurological diseases. According to the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF) the participation, which is involvement in a life situation, will be affected due to these physical (body structure) and psychological (body functions) destructions caused by falling.

The factors negatively affecting falling in patients with NMD should be determined in order to assure the safe mobility of the patients by preventing the falls with an appropriate treatment program. Therefore, prevention of falls will most probably help the patients to keep their activity and participation in higher level. The aims of this study were to compare the muscle strength, mobility level and quality of life in faller and non-faller patients with neuromuscular diseases and to determine the correlation of these parameters with falling frequency.

## MATERIALS AND METHODS

### Participants:

Eighty patients (37 female and 43 male) with various NMD, who applied to neurological rehabilitation outpatient clinic, were included to this prospective study. All patients had signed a written consent at the beginning of this study. Ambulatory patients over the age of 18, diagnosed by a neurologist were included while patients having neurological symptoms and other kind of balance compromising factors were excluded. None of the patients had used walking aids.

The age, gender, disease duration and medication history of the faller and non-faller patients were examined. The patients were classified as fallers if they fall at least two times in

and non-faller groups ( $p < 0.05$ ). There was a difference in right and left hip flexors, knee extensors and ankle dorsiflexors muscle strength in two groups. The difference of the total neck and trunk muscle was not statistically significant. Also, the mobility level measured by RMI (Rivermead Mobility Index) was not different in both groups. The HRQOL of the patients in the fallers and non-fallers group measured with NHP was found to be different, and considering the NHP parameters the 'physical activity' and 'social isolation' parameters was statistically different.

Falling frequency was found to be correlated with fear of falling ( $r = 0.437$ ) ( $p < 0.05$ ), on the other hand no statistically significant correlation was found between falling frequency and falling environment (Table 3). A significant correlation was obtained between falling frequency and both right and left knee extensors muscle strength ( $r = -0.388$  ( $p < 0.05$ ) and  $r = -0.419$  ( $p < 0.05$ ), respectively). Neither the total lower extremity muscle strength nor the individual muscle strength of the hip flexors and ankle dorsiflexors was found to be correlated with falling frequency. Additionally, the mobility level and HRQOL was not found to be correlated with falling frequency.

## DISCUSSION

The results of this study revealed that the hip flexors, knee extensors and ankle flexors muscle strength were lower in the fallers group comparing to the non-fallers group. These findings were also compatible with the HRQOL of the patients. Therefore, the total NHP score and, 'physical activity' and 'social isolation' parameters of the NHP were lower in the non-fallers group, indicating a better health status comparing to the fallers group.

Although the place of falling (indoor or outdoor) was not correlated with falling frequency, fear of falling of the faller patients was found to be correlated with falling frequency. Amongst the three muscle groups (hip flexors, knee extensors and ankle flexors) only the knee extensors muscle strength was found to be correlated with falling frequency.

The study of Pieterse et al showed that the most frequent risk factor for falling was lower extremity muscular weakness, which was reported in 94% of the patients with various NMD.<sup>18</sup> In this study the total eight lower extremity muscle group (hip flexors, extensors, abductors and adductors, knee flexors and extensors, ankle flexors and extensors) strength were found to be relatively higher in the fallers group comparing to the non-fallers group. However, particularly the strength of the three muscle groups (hip flexors, knee extensors and ankle flexors) were lower in the fallers group. Therefore, these three muscle groups can be more determinative of faller and non-faller NMD patient groups.

In the study of Daubney and Culham,<sup>29</sup> the ankle flexors were found to be the best predictor of falling in the elderly, which was also compatible with the findings of the other studies.<sup>30-32</sup> This was explained by the importance of the ankle dorsiflexors, together with hip and knee flexors, for lifting the leg to allow an adequate clearance of the foot over the ground during the swing phase. On the other hand, the muscle strength of knee extensors was shown to be the main determinant of functionality and balance in NMD previously.<sup>33,34</sup> In this current study, the knee extensors muscle strength was found to be as an important factor affecting falling due to the giving way of the knee, which was the most frequently seen cause of falling in our study group. Understanding the mechanism of falls may be helpful for protective, supportive and treatment strategies of patients with NMD.

The previous study of Pieterse et al indicated that falling was accompanied by fear of falling (57%) and reduced activities (48%) in this group of patients.<sup>18</sup> In this study, considering the faller patients 94% have reported that they fall in an outdoor environment and 73% have defined fear of falling. The augmentation of falling frequency may stimulate fear of falling, especially in outdoor activities, therefore patients may reduce their physical activities and this may lead to isolation of these patients from their social environment. The isolation of these patients from outdoor events may lead to a more decreased physical activity

**Table 1. Characteristics of the subjects in the fallers and non-fallers groups.**

	Fallers (N=49)	Non-fallers (N=31)	p
	X±SD	X±SD	
Age (years)	31.16±12.43	28.25±19.92	0.446*
Body weight (kg)	63.0±11.8	65.0±13.7	0.756*
Height (cm)	166.82±10.3	170.29±10.4	0.173*
Body mass index (kg/m <sup>2</sup> )	23.0±3.7	23.1±3.1	0.910*
Disease duration (month)	46.1±70.1	42.3±57.1	0.921*
Falling frequency	2.7±1.3	-	
	n (%)	n (%)	
Gender (Male/Female)	24/25 (49/51)	19/12 (61/39)	
Use of psychoactive medicine	1 (2%)	- (0%)	
Use of antihypertensive medicine	2 (4%)	- (0%)	

\* p>0.05.

**Table 2. The comparison of the mobility level, health related quality of life and muscle strength of the individuals in the fallers and non-fallers groups.**

	Fallers (N=49)	Non-fallers (N=31)	p
	X±SD	X±SD	
Rivermead Mobility Index (0-15)	12.6±2.8	13.4±1.5	0.489*
<b>Nottingham Health Profile</b>			
Energy Level (0-100)	50.7±34.9	36.7±30.7	0.081*
Pain(0-100)	21.1±29.6	13.2±21.5	0.082*
Emotional Reactions (0-100)	29.7±27.7	19.2±22.5	0.060*
Social Isolation (0-100)	17.3±22.0	8.3±14.5	0.025**
Sleep (0-100)	18.2±22.1	17.7±22.5	0.920*
Physical Activity (0-100)	43.0±23.4	23.6±15.2	0.000**
Total (0-600)	180.6±115.8	118.4±90.5	0.019**
<b>Muscle strength (0-5)</b>			
Total Upper Extremity	150.1±11.8	141.6±15.8	0.015**
Total Lower Extremity	61.4±9.8	58.0±12.7	0.273*
Right Hip Flexors	3.5±1.0	4.1±1.1	0.014**
Left Hip Flexors	3.6±1.1	4.1±1.0	0.035**
Right Knee Extensors	3.6±1.5	4.6±0.7	0.004**
Left Knee Extensors	3.6±1.0	4.0±1.1	0.046**
Right Ankle Flexors	3.5±1.1	4.1±1.0	0.034**
Left Ankle Flexors	3.6±1.5	4.5±0.8	0.011**
Trunk	7.7±1.8	7.8±1.7	0.917*
Neck	8.8±1.7	8.9±1.6	0.902*

\* p>0.05, \*\* p<0.05.

**Table 3. The correlation of falling frequency with mobility level, health related quality of life and muscle strength in the fallers group (N=49).**

	Falling frequency	
	r	p
<b>Age</b>	0.064	0.662*
<b>Disease duration</b>	0.059	0.687*
<b>Rivermead Mobility Index</b>	-0.245	0.090*
<b>Nottingham Health Profile</b>		
Energy Level	0.159	0.275*
Pain	0.147	0.315*
Emotional Reactions	0.222	0.125*
Social Isolation	0.198	0.172*
Sleep	0.234	0.106*
Physical Activity	0.204	0.161*
Total	0.212	0.143*
<b>Muscle strength</b>		
Total Upper Extremity	-0.014	0.932*
Total Lower Extremity	-0.082	0.575*
Right Hip Flexors	-0.078	0.593*
Left Hip Flexors	-0.064	0.664*
Right Knee Extensors	-0.388	0.006**
Left Knee Extensors	-0.419	0.003**
Right Ankle Flexors	-0.020	0.893*
Left Ankle Flexors	0.020	0.893*
Trunk	-0.118	0.418*
Neck	0.020	0.889*

\* p>0.05, \*\* p<0.05. Spearman's Rho Correlation Analysis.

level, which may also affect the psychological state of the patients. Therefore, falling is not only a physical demolition but also a psychological destruction and the treatment strategies for patients with NMD should include both physical and psychological aspects.

One of the limitations of this study was using a self-reported scale in the assessment of number of falling, fear of falling, reasons of falling, place of falling and injurious falling of the patients. The incidence of falls by using the memory recalls may not be reliable due to the underestimation or exaggeration of the patients. Therefore, further studies may prefer to use a diary of falling rather

than using falls recall in order to obtain more reliable information about falling. Another limitation of the current study was the study population, which was mainly comprised of patients with myopathy. Hence the results of this study are tentative for other groups of NMD. Further studies are required for identifying the risk factors of falling in other types of NMD.

In conclusion, although the total lower extremity muscle strength results of the faller subjects was relatively higher comparing to the non-faller subjects, the isolated muscle strength results of the hip flexors, knee extensors and ankle dorsiflexors are lower in the faller subjects. However, only the knee extensors muscle strength was found to be as an important factor affecting falling frequency in patients with NMD. Hence, the patients with reduced knee extensors muscle strength are more prone to fall, especially in outdoor activities. The HRQOL of the faller subjects, particularly 'physical activity' and 'social isolation' parameters, are lower comparing to non-faller subjects. The faller NMD patients have reduced physical activity level, hence, this may lead to isolation from the social environment and more decreased activity level. Therefore, the treatment program of patients with NMD should include both physical and psychological approaches.

## REFERENCES

1. Wild D, Nayak US, Issacs B. Description, classification and prevention of falls in old people at home. *Rheumatol Rehabil.* 1981;20:153-159.
2. King MB, Tinetti ME. Falls in community-dwelling older persons. *J Am Geriatr Soc.* 1995;43:1146-1154.
3. Stalenhoef PA, Crebolder HFJM, Knottnerus A, et al. Incidence, risk factors and consequences of falls among elderly subjects living in the community. *Eur J Public Health.* 1997;7:328-334.
4. Tromp AM, Pluijm SMF, Smit JH, et al. Fall-risk screening test: a prospective study on predictors for falls in community-dwelling elderly. *J Clin Epidemiol.* 2001;54:837-844.
5. Salgado RI, Lord SR, Ehrlich F, et al. Predictors of falling in elderly hospital patients. *Arch Gerontol Geriatr.* 2004;38:213-219.
6. Vassallo M, Vignaraja R, Sharma JC, et al. Predictors for falls among hospital inpatients with impaired mobility. *J R Soc Med.* 2004;97:266-269.

7. Keskin D, Borman P, Ersöz M, et al. The risk factors related to falling in elderly females. *Geriatr Nurs.* 2008;29: 58-63.
8. Li W, Keegan TH, Sternfeld B, et al. Outdoor falls among middle-aged and older adults: a neglected public health problem. *Am J Public Health.* 2006; 96: 1192-1200.
9. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. *N Engl J Med.* 1988;319:1701-1707.
10. Campell AJ, Borrie MJ, Spears GF, et al. Circumstances and consequences of falls experienced by a community population 70 years and over during a prospective study. *Age Aging.* 1990;19: 36-141.
11. Tinetti ME, Lui WL, Claus EB. Predictors and prognosis of inability to get up after falls among elderly persons. *JAMA.* 1993;269:65-70.
12. Kannus P, Niemi S, Palvanen M, et al. Fall-induced injuries among elderly people. *Lancet.* 1997;350:1174.
13. Zijlstra GAR, van Haastregt JCM, van Eijk JTM, et al. Prevalence and correlated of fear of falling and associated avoidance of activity in the general population of community-living older people. *Age Aging.* 2007;36:304-309.
14. Teasell R, McRae M, Foley N, et al. The incidence and consequences of falls in stroke patients during inpatient rehabilitation: factors associated with high risk. *Arch Phys Med Rehab.* 2002;83:329-333.
15. Lamb SE, Ferrucci L, Volapto S, et al. Risk factors for falling in home-dwelling older women with stroke: the Women's Health and Aging Study. *Stroke.* 2003;24:494-501.
16. Pickering RM, Grimbergen YAM, Rigney U, et al. A meta-analysis of six prospective studies of falling in Parkinson's disease. *Mov Disord.* 2007;22:1892-1900.
17. Wielinski CL, Erickson-Davis C, Wichmann R, et al. Falls and injuries resulting from falls among patients with Parkinson's disease and other parkinsonian syndromes. *Mov Disord.* 2002;20:410-415.
18. Pieterse AJ, Luttikhoud TB, de Laat K, et al. Falls in patients with neuromuscular disorders. *J Neurol Sci.* 2006;251:87-90.
19. Wiles CM, Busse ME, Sampson CM, et al. Falls and stumbles in myotonic dystrophy. *J Neurol Neurosurg Psychiatry.* 2006;77:393-396.
20. Stel VS, Pluijm SM, Deeg DJH, et al. A classification tree for predicting recurrent falling in community-dwelling older persons. *J Am Geriatr Soc.* 2003;51:1356-1364.
21. Lach HW, Reed AT, Arfken CL, et al. Falls in the elderly: reliability of a classification system. *J Am Geriatr Soc.* 1991;39:197-202.
22. O'Loughlin JL, Robitaille Y, Boivin JF, et al. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. *Am J Epidemiol.* 1993;137:342-354.
23. Atsushi K, Hiroaki N, Masuo S, et al. Muscle strength evaluation by the measurement sum of several motions using a manual myometer. *Jpn J Rehabil Med.* 1999;36:237-239.
24. Collen FM, Wade DT, Robb GF, et al. The Rivermead Mobility Index: a further development of the Rivermead Motor Assessment. *Int Disabil Stud.* 1991;13:50-54.
25. Rossier P, Wade DT. Validity and reliability comparison of 4 mobility measures in patients presenting with neurologic impairment. *Arch Phys Med Rehabil.* 2001;82:9-13.
26. Akın B, Emiroglu ON. The validity and reliability of the Turkish version of Rivermead Mobility Index in the elderly. *Turkish Journal of Geriatrics.* 2007;10:124-130.
27. Hunt SM, McKenna SP, McEwen J, et al. The Nottingham Health Profile: subjective health status and medical consultations. *Soc Sci Med [A].* 1981; 15:221-229.
28. Küçükdeveci AA, McKenna S, Kutlay S, et al. The development and psychometric assessment of the Turkish version of the Nottingham Health Profile. *Int J Rehabil Res.* 2000;23:31-38.
29. Daubney MD, Culham EG. Lower extremity muscle force and balance performance in adults aged 65 years and older. *Phys Ther.* 1999;79:1177-1185.
30. Macrae PG, Lacourse M, Moldavon R. Physical performance measures that predict fall status in community-dwelling older adults. *J Orthop Sports Phys Ther.* 1992;16:123-128.
31. Lord SR, Clark RD, Webster IW. Physiological factors associated with falls in an elderly population. *J Am Geriatr Soc.* 1991;39:1194-1200.
32. Studenski S, Duncan PW, Chandler J. Postural responses and effector factors in persons with unexplained falls: results and methodological issues. *J Am Geriatr Soc.* 1991;39:229-234.
33. Carter ND, Khan KM, Mallinson A, et al. Knee extension strength is a significant determinant of static and dynamic balance as well as quality of life in older community-dwelling women with osteoporosis. *Gerontology.* 2002;48:360-368.
34. Lindeman E, Leffers P, Reulen J, et al. Quadriceps strength and timed motor performances in myotonic dystrophy, Charcot-Marie-Tooth disease and healthy subjects. *Clin Rehabil.* 1998;12:127-135.