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Objective and Subjective Assessment of Physical Activity in Adults with Muscle Diseases

Erişkin Kas Hastalarında Fiziksel Aktivitenin Objektif ve Subjektif Değerlendirmesi

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Abstract

Objective: The aim of this study was to investigate the physical activity of adults with muscle diseases relative to healthy controls.

Materials and Methods: Individuals participated in this cross-sectional study by completing International Physical Activity Questionnaire - Long version and using SenseWear Armband Activity Monitor over a 5-day period to assess physical activity levels subjectively and objectively.

Results: Forty healthy controls (16 male, 24 female) (30.40±4.55 years) and 40 adults with muscle diseases (21 male, 19 female) (32.67±6.57 years) participated in this study. We found that SenseWear Armband (Step counts, duration of moderate physical activity and vigorous physical activity) and International Physical Activity Questionnaire (Walking physical activity, vigorous physical activity, working physical activity and total physical activity) parameters were significantly lower in the adults with muscle disease group than the healthy controls group ($p<0.05$); whereas the total amount of energy expenditure was similar between the groups ($p>0.05$).

Conclusion: In conclusion, adults with muscle diseases expends the same amount of energy as healthy controls, but over fewer steps. This difference between energy expenditure and number of steps could be due to the higher energy requirements for walking in the adults with muscle diseases. These findings will help healthcare professionals plan treatment strategies for adults with muscle diseases.

Keywords: Physical activity, chronic disease, energy expenditure

Öz

Amaç: Bu çalışmanın amacı, erişkin kas hastalarının fiziksel aktivitelerini sağlıklı bireylerle karşılaştırarak araştırmaktır.

Gereç ve Yöntem: Bu kesitsel çalışmaya katılan bireyler, fiziksel aktivite düzeylerinin subjektif ve objektif olarak değerlendirilmesi için Uluslararası Fiziksel Aktivite Anketi-Uzun Versiyon'u tamamladı ve bireylere 5 gün boyunca SenseWear Armband Aktivite Monitörü takıldı.

Bulgular: Çalışmaya 40 erişkin kas hastası (21 erkek, 19 kadın) (32.67±6.57 yıl) ve 40 sağlıklı kontrol (16 erkek, 24 kadın) (30.40±4.55 yıl) katıldı. SenseWear Armband'dan elde edilen adım sayısı, orta şiddetli fiziksel aktivite süresi ve şiddetli fiziksel aktivite süresi; Uluslararası Fiziksel Aktivite Anketi'nden elde edilen yürüyüş aktivitesi, şiddetli fiziksel aktivite, iş aktivitesi ve toplam fiziksel aktivite parametreleri erişkin kas hastalarında sağlıklı kontrollere göre anlamlı düzeyde düşük bulunurken ($p<0.05$); toplam enerji harcaması gruplar arasında benzer bulundu ($p>0.05$).

Sonuç: Sonuç olarak, erişkin kas hastaları sağlıklı kontrollerle daha az adım sayısında aynı miktarda enerji harcadılar. Enerji harcaması ve adım sayısı arasındaki bu fark, erişkin kas hastalarında yürümek için daha yüksek enerji gereksinimlerine bağlı olabilir. Bu bulgular, sağlık çalışanlarının erişkin kas hastaları için tedavi stratejilerini planlamasına yardımcı olacaktır.

Anahtar Kelimeler: Fiziksel aktivite, kronik hastalık, enerji harcaması

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Introduction

Physical activity (PA) is defined as any movement produced by skeletal muscles that results in energy expenditure (EE) above the basal level (1). PA is an important factor in the improvement of health and prevention of diseases. In individuals with physical and functional restrictions; PA is important because of the risk of a worsening of serious health problems (2). Individuals might adopt an inactive life because of tiredness, pain, contracture, breathing problems, exercise intolerance or progressive muscle weakness. Moreover, maintaining an inactive lifestyle increases the risk of secondary problems, such as coronary artery disease, obesity, osteoporosis, anxiety, and depression (3). Thus, it is particularly important to improve the PA level of adults with muscle disease (AwMD) (3).

Most studies related to the PA of AwMD groups have focused on pediatric muscle diseases (4-5). A small number of the studies on AwMD have also shown that PA is affected more in the presence of neuromuscular diseases than in healthy individuals. McCrory et al. (6) found that the total EE of the individuals with a neuromuscular disease was lower than the healthy group because they spent less time doing PA and their EE was higher in very vigorous physical activity (VVPA). It is remarkable that almost all of the previous studies that have included adult neuromuscular disease groups, such as those with neuropathy, myopathy or CMT (Charcot-Marie-Tooth diseases), were assessed in the scope of the same study. Factors such as symptoms, age at onset, affected body structure and functions, which can all directly affect physical activity, differ from one neuromuscular disease to another. Therefore, disease-specific measurements are likely to be more reliable.

Previous studies in this area suffer from some problems. For example, usually only an objective or subjective assessment method is applied (7), which has some disadvantages. For example, questionnaires are insufficient for assessments of the sedentary activity level, whereas measurements made using activity monitors reflect all PA levels but cannot identify the different PA types. Thus, there is a need for studies which assesses PA in a comprehensive way with its all parameters.

Here we assessed the PA of AwMD group relative to a matched healthy control (HC) group, including the number of steps, EE, time spent in PA of different intensities, and different PA metabolic equivalents (Metabolic equivalent-MET)-min/week values, using both objective and subjective methods.

Materials and Methods

Participants

This cross-sectional study was conducted at Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, between January 2016 and January 2017, after the necessary permission and approval was received from the university research ethics committee (Registration number GO 14/617).

The study included 45 patients diagnosed with muscle diseases by a neurologist and 44 voluntary, healthy participants.

For the AwMD group, the inclusion criteria were: between 20 and 40 years old; with a muscle disease diagnosis; and able to walk independently (Not using assistive devices and able to walk independently for at least 500 m). The exclusion criteria for the AwMD group were: systemic problems (E.g., diabetes mellitus or hypertension); had a surgical operation in the last 6 months; have additional orthopedic problems that affect PA performance; have any serious neurological diseases except the muscle disease; or have cognitive problems or co-operation difficulty.

For the HC group, the inclusion criteria was being between 20 and 40 years old, and the exclusion criteria were: any orthopedic and neurological problems that might interfere with PA; systemic problems (E.g., diabetes mellitus or hypertension); or have had a surgical operation in the last 6 months.

The study was explained in detail to the individuals who had accepted to be included in the study, and informed consent forms were signed.

Design

The demographic characteristics of the individuals, such as age, height, weight, and BMI were recorded. Then, detailed information about the use of the SenseWear Pro 3 Armband (BodyMedia, Inc, Pittsburg, PA, USA) activity monitor was given to all participants. The individuals were asked to wear the activity monitor on the triceps muscle of their right arm, and to remove it only during swimming and showering. The individuals were asked to put on the device as soon as they woke each morning, and they scheduled an appointment for 5 days later. All individuals in the study were asked to use the device for 5 days, which were planned as two weekend days and three weekdays. At the follow-up appointment, individual and anthropometric values were entered into the system, and the device was configured. Then, the data saved on the device were transferred to a computer using the SenseWear Professional Software (Version 8.1). The individuals were informed about the total number of steps, total EE, the daily number of steps and EE, as well as time spent in PA of different intensities. The PA levels were also assessed using the IPAQ-Long Form.

Evaluations

Subjective Assessment of Physical Activity Level with IPAQ Long Version

The PA of the participants was subjectively assessed using the Turkish version of the IPAQ - Long Form (8). This questionnaire can be completed quickly and easily and assesses PA, which is classified according to its intensity. The questionnaire consists of 27 questions that address the duration the individuals spend on different physical activities during the last 7 days, seven questions address physical activity related to work, seven questions address transportation, six questions address the housework, house maintenance and caring for family, six questions address recreation, sports, and leisure time, and two questions address the time spent sitting on weekdays and the weekend (9).

Objective Assessment of Physical Activity Level with SWA

The PA of the participants was assessed objectively using SenseWear Pro 3 Armband (BodyMedia, Inc, Pittsburgh, PA, USA) multisensory activity monitors. The data were analyzed using the SenseWear Professional Software (Version 8.1) (10).

The SWA is an activity monitor that includes multi-sensors, such as a galvanic skin response sensor to assess the electrical resistance differences of the skin, a heat flow sensor, and a skin temperature sensor to assess the heat change and consists of 2 axes. This variety of sensors give the device a high-level of sensitivity for detecting differences in EE related to complex life changes, which can be difficult to detect (11). While worn, the SWA constantly records and collects the physiological state and movement information of the wearer (12). The system records the values of the individual, such as total EE, active EE, the total number of steps, duration in PA of different intensity, and sleep duration. The intensity of PA is classified according to MET cut-offs of 1.5-3 for light physical activity (LPA), MET 3-6 for moderate physical activity (MPA), MET 6-9 for vigorous physical activity (VPA), and MET>9 for VVPA (13). Studies conducted using the SWA have shown that this device shows the total EE, active EE, number of steps, duration of lying, sleep and physical activity with greater than 90% accuracy (14).

Statistical analysis

The data were analyzed using SPSS 20.0. The values are presented as the mean ± standard deviation (±SD), number (n), and percentage (%). The normal distribution of the obtained data was evaluated visually (Histogram and probability plots) and using the Kolmogorov-Smirnov/Shapiro-Wilk tests. Nonparametric tests were used because the obtained data were not normally distributed. Independent samples t-test and Chi-Square tests were used to determine the statistical significance of differences between the groups; the Mann-Whitney U test was used to determine whether there were differences in terms of physical activity parameters. P-values less than 0.05 were considered statistically significant.

The power of the study was calculated using the Gpower 3.0.10 analysis program. The SenseWear total number of steps results were used to determine the power of the study. Means, standard deviations, and sample sizes of groups were used to calculate the achieved power. According to these analyses, the study achieved a power of 98.32%.

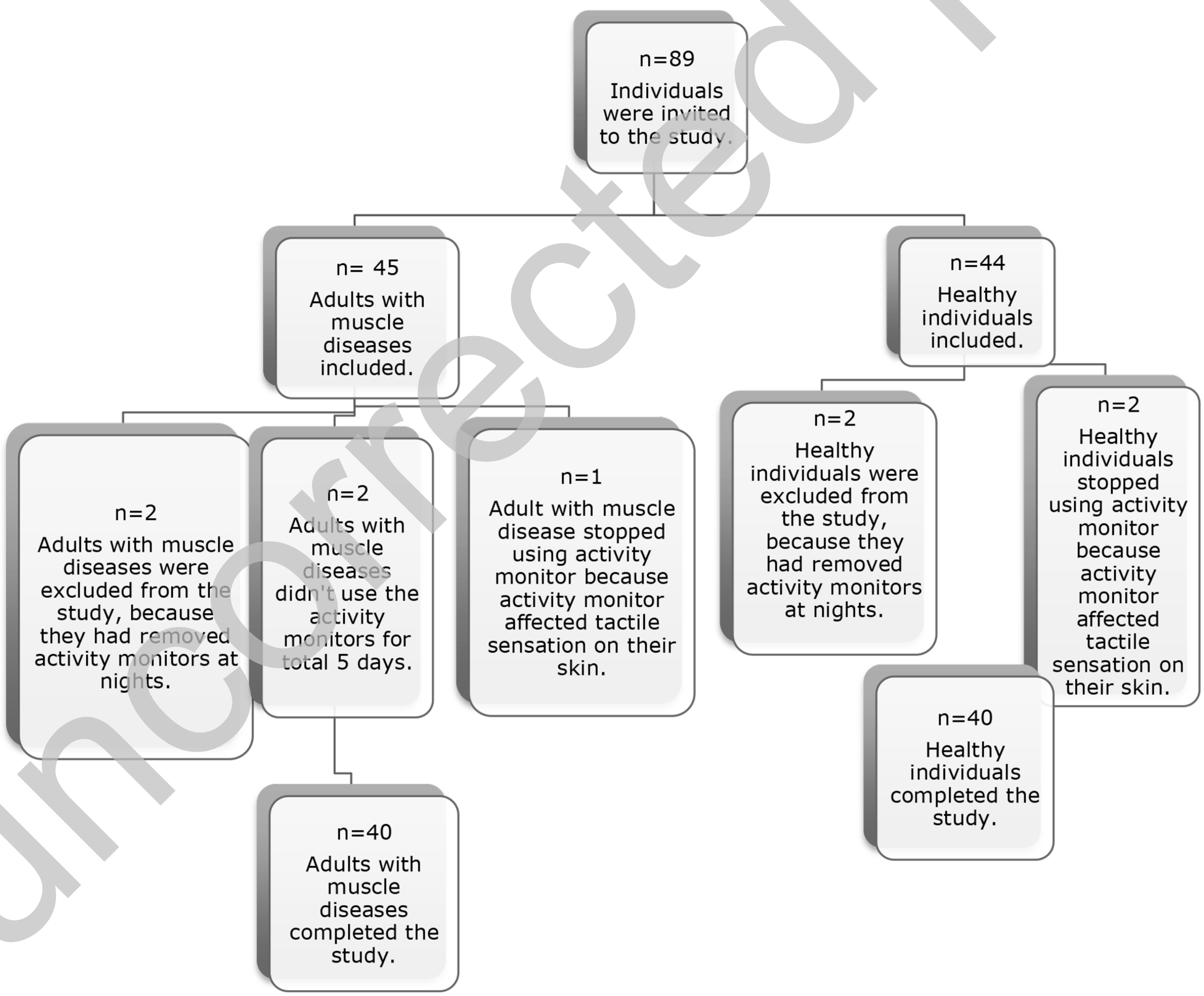

Figure 1. The flow chart of the study

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The data of volunteers who could not continue to study were not included in the statistical analysis.

Results

Demographics and baseline characteristics

From an original 45 AwMD and 44 HC volunteers, nine were excluded. Forty adults with muscle diseases (Twelve myopathies, 2 distal myopathies, 5 muscular dystrophies, 6 limb-girdle muscular dystrophies, 6 facioscapulohumeral muscular dystrophies, 4 myotonic dystrophies, 4 becker muscular dystrophy, and 1 inclusion body myositis) (21 male, 19 female) and 40 healthy individuals (16 male, 24 female) completed the study. A flowchart of the study is given in Figure 1.

The groups had similar age, height, weight, gender, and body mass index (BMI) ($p>0.05$) but different job states ($p<0.05$) (Table 1).

SWA: objectively assessed PA

Comparing the AwMD and HC group, by SWA, we detected a significant difference in the total number of steps, duration of MPA, and VPA ($p<0.05$) (Table 2).

IPAQ: subjectively assessed PA

Comparing the weekly total PA findings, we found that the walking PA, VPA, total PA, and working PA of the AwMD were significantly lower than for the HC group ($p<0.05$). No differences were found between the groups for MPA or other activity types ($p>0.05$) (Table 3).

Discussion

To our knowledge, this is the first original study to evaluate the PA of adults with muscle disease group by both objective and subjective methods. We found that the AwMD group expends the same amount of energy as the matched HC group, but take fewer steps.

Several studies have investigated the daily average number of steps of the individuals with neurological diseases and pediatric individuals with muscle disease decreases (5,15,16). Some studies have reported a reduced number of steps by AwMD, but none of these studies have described the relationships between this situation and other physical activity parameters (17). Our finding that the AwMD group took fewer steps than the HC group was expected (7). The fewer steps but similar EE of the two groups can be accounted for by the AwMD group using more energy while walking (18). For example, individuals whose dorsiflexor muscles are weak try to minimize the risk of falling by making the steppage gait with the hip and knee flexion, thereby spends more energy (19). High levels of EE in muscle diseases have some risks. For this reason, while aiming to increase the number of steps, EE levels need to be controlled carefully. Thus, in this disease group, approaches for the protection and improvement of PA levels should be adopted by using energy protection techniques, such as the analysis and modification of the activities, balancing the working and resting time, determining the priorities in daily life activities (and modifying them), effective use of the body, organizing the workplace, and using the assistive technologies (20).

We found that the AwMD group spends less time in MPA and VPA than the HC group, whereas SPA, LPA, and VVPA durations are similar between the groups. In the physical activity guidelines published for healthy individuals, it has been emphasized that it is necessary to do at least 150 min of MPA and 75 min of VVPA per week (21). Other studies have aimed to determine the weekly physical activity durations in different neurological diseases and elder individuals (22,23). There have been none studies and physical activity guides which state the effects of different levels of exercises in the AwMD population (24). Lower VPA durations can be advantageous for individuals with muscle disease. This

Table 1. Demographics of the individuals

	AwMD Group Mean±SD (n=40)	HC Group Mean±SD (n=40)	t	p
Age (years)	32.67±6.57	30.40±4.55	1.800	0.076
Height (cm)	170.35±9.36	169.17±9.10	0.569	0.571
Weight (kg)	70.30±15.47	65.80±13.48	1.386	0.170
BMI (kg/m^2)	24.39±4.23	22.81±2.81	1.959	0.054
Gender (male/female)	21/19	16/24		0.502
Job state (employed/unemployed)	21/19	38/2		0.001**
Onset of the complaints (months)	147.30±113.28			
Duration of the disease (months)	71.25±70.12			
Exercise behaviour (exist/doesn't exist)	32/8			

AwMD: Adults with muscle diseases; HC: Healthy controls; BMI: Body mass index.
*$p<0.05$, t-Test, **$p<0.05$, Chi-Square Test

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Table 2. Objective assessment – SWA results of the AwMD group and the HC group

	AwMD Group Mean±SD (n=40)	HC Group Mean±SD (n=40)	p
Total number of steps (number/5 days)	29603.42±15720.30	45680.62±18129.02	0.0001*
Total EE (kcal)	11431.50±3586.14	11953.57±2692.42	0.209
Total active EE (kcal)	4856.42±3182.14	4949.72±2253.40	0.366
Total duration of SPA (min)	5214.77±980.73	5184.37±998.21	0.700
Total duration of LPA (min)	1224.52±766.92	1221.17±919.18	0.713
Total duration of MPA (min)	286.27±28.95	483.02±237.76	0.0001*
Total duration of VPA (min)	21.52±24.88	52.22±52.47	0.003*
Total duration of VVPA (min)	0.37±0.80	1.35±2.87	0.359

SWA: SenseWear Armband; AwMD: Adults with muscle diseases; HC: Healthy controls; EE: Energy expenditure; SPA: Sedantary physical activity; LPA: Light physical activity; MPA: Moderate physical activity; VPA: Vigorous physical activity; VVPA: Very vigorous physical activity
*p<0.05, Mann Whitney U Test.

Table 3. Subjective assessment – IPAQ long version results of the AwMD group and the HC group

	AwMD Group Mean±SD (n=40)	HC Group Mean±SD (n=40)	p
Total PA (MET-min/week)	3720.68±2650.19	6177.56±4631.30	0.027*
MPA (MET-min/week)	1745.40±1806.50	2522.00±2692.66	0.319
VPA (MET-min/week)	230.00±460.25	845.00±1399.28	0.010*
Walking PA (MET-min/week)	1854.18±1611.91	2810.77±2362.01	0.047*
Working PA (MET-min/week)	1254.08±2134.25	3466.58±3254.97	0.0001*
Transportation activities (MET-min/week)	934.83±939.36	987.11±1012.47	0.754
Housework activities (MET-min/week)	902.50±1258.47	882.75±1155.37	0.478
Leisure time activities (MET-min/week)	794.26±814.42	689.41±843.12	0.277
Sitting duration (min)	2523.00±908.41	2258.25±789.64	0.258

AwMD: Adults with muscle diseases; HC: Healthy controls; PA: Physical activity; MET: Metabolic equivalent; MPA: Moderate physical activity; VPA: Vigorous physical activity
*p<0.05, Mann Whitney U Test.

is because, in individuals with muscle disease, VPA can lead to damage to the continuity of sarcolemma, thereby increasing the degeneration of muscle fibers (25). However, increasing the duration of MPA in AwMD should be one of the main aims of physiotherapists.

Using the IPAQ data, we found that the VPA level (MET-min/week) was lower in the AwMD group than the HC group, which is in line with our activity monitor findings. In addition, we found that total PA, walking PA, and working PA (MET-min/week) values are lower in the AwMD than HC group. Unlike SWA, IPAQ MPA results did not differ between the HC and AwMD groups. Because the questionnaires inadequately reflect non-vigorous (Moderate and light) activities (26), we rely mostly on the SWA results when presenting our conclusions. On the other hand, the IPAQ assesses the PA enabled us to investigate the PA of AwMD with greater detail. For example in the SWA, there is not a separate parameter which assesses the walking activity separately. This deficiency was compensated by the IPAQ.

Our finding that participation in working activities is lower in the AwMD than HC group was expected because 95% of the HC group work, whereas only 52.5% of AwMD group work. It is important to enable the employment of the AwMD by directing

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them to professions appropriate for the severity of their disease (27). Increasing the PA of AwMD decreases the risk of problems peculiar to their disease as well as the development of secondary problems, such as coronary artery disease, obesity, osteoporosis, anxiety, and depression (3). Thus, increasing the PA of AwMD patients would likely reduce healthcare costs (28).

Including only those AwMD able to walk is a limitation of our study. However, if we had included AwMD who cannot walk, this would have introduced great variability in the PA levels of this group, making it difficult to generalize our findings.

Conclusion

In conclusion, we found that fewer steps were taken by a group of AwMD patients than HC participants. However, both groups expend the same amount of energy. According to this result, EE should also be considered while aiming to increase the number of steps of AwMD patients. Compared to the HC group, we found that the AwMD group spend less time in MPA and VPA. Physicians should only attempt to increase the MPA levels of patients because increased VPA is risky for muscle disorder patients. Further work needs to be done to investigate the factors that lead to a decrease in physical activity in order to better understand the physical activity behaviors of AwMD.

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