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Original Article

Detection of early symptoms of cumulative trauma disorders among mothers of handicapped children: a pilot study

Gulsah Kinali[1)*], Ferda Dokuztuğ Üçsular[2)]

[1)] *Physiotherapy and Rehabilitation Department, Istanbul Gelişim University College of Health: 34310, Avcılar, İstanbul, Turkey*
[2)] *Pyhsiotherapy and Rehabilitation Department, Faculty of Health Sciences, Istanbul Bilim University, Turkey*

Abstract. [Purpose] This study aimed to establish a scientific and clinical basis for the development of a method for the early diagnosis of cumulative trauma disorders experienced by mothers of disabled children. [Subjects and Methods] Ten volunteer mothers who came to a rehabilitation centre for the treatment of their children were included in this study. Surface electromyography measurements were taken during maximum isometric contraction through the extensor muscle motor point of the wrist of the mothers, and hand grip strength was measured. [Results] In the electromyography measurements, the mean electromyogram signal value obtained from the wrist extensor muscle motor point of the mothers of the healthy children was 0.3 ± 0.08 mV and the crude handgrip strength was 28.5 ± 2.08 kg. In mothers of rehabilitated children, the crude hand grip strength was 7.0 ± 1.1 kg, and the mean electromyogram signal value from the extender muscle motor point was 0.1 ± 0.02 mV. There was a significant difference between the mothers with healthy and disabled children with respect to handgrip strength and electromyography. [Conclusion] The result obtained may be important in the development of health protection programs. Further research may lead to the development of protective rehabilitation programs and the improvement of social rights for mothers with disabled children.

Key words: Handicapped children mothers, Cumulative trauma disorders, Early diagnosis

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INTRODUCTION

Despite the decreased incidence of birth trauma and improving new born health care in our country and the world, the status of developmental disorders due to non-preventable causes and resulting disability are present considerations[1)]. Disabled individuals constitute a substantial part of the society, and according to the latest data, account for 12.9% of the population[2)]. Although disability groups have different individual classifications, a significant proportion of the children who come to rehabilitation centres have cerebral palsy. Cerebral palsy is a type of brain injury that occurs when the developing brain is damaged by various causes before, during, and after birth. Its prevalence is 3–4 per 1,000 births. Depending on the level of damage and the affected brain area, it may cause physical and cognitive problems[3, 4)]. While some cerebral palsy types cause no physical dependence, in some cases, the level of disability may also increase depending on the extent of brain damage. Individuals with severe physical disability are dependent on their mothers from the early stages of life until adulthood. The number of mothers who take care of these children's health care, transfers, and daily activities is also as notable as the number of children. The daily care and transfer of disabled individuals are challenging. In places where there are architectural deficiencies and public transport is not designed for disabled individuals, mothers most often make the first attempt for the

*Corresponding Author. Gulsah Kinali (E-mail: gulsah.kinali@gmail.com)

transportation and lifting of disabled children. Consequently, a mother with a disabled child is prone to cumulative trauma disorders. Cumulative trauma disorder is a term used to describe musculoskeletal problems that are experienced by the individuals who have to continuously perform a job[5].

The hand is a very complex region of the body, with the functions of gripping, holding, and feeling. The hand region, and especially the thumb, occupies a much larger area in the brain than other body regions. Moreover, it is also the most commonly used body part and the site where cumulative trauma disorders occur most frequently. The carpal tunnel syndrome, tenosynovitis, and other entrapment neuropathies also occur in this region[6].

Mothers with disabled children experience physical and psychological burdens overtime. Adjusting to having a child with a disability is an extensive process which starts from the shock phase and extends to the acceptance phase. While the mother passes through these phases, she is frequently unaware that she is physically exposed to a burden above normal and over time, she experiences cumulative trauma. Studies involving these mothers have been conducted in the field of psychology; however, to our knowledge, no Turkish study has attempted to explain and visualise the physical load on mothers[7–10]. The aim of this study was to evaluate the hand muscles of the mothers of disabled children using objective methods and to prepare the basis for studies on the prevention of possible cumulative trauma disorders in mothers.

SUBJECTS AND METHODS

A total of 20 volunteer mothers, including 10 mothers of healthy children (control group) and 10 mothers of disabled children (with cerebral palsy), participated in this study after being informed about the study and providing consent. Demographic characteristics such as age, height, and weight of the mothers and the age of the children were recorded. Wrist extensor muscle electromyography was performed on the mothers with the BIOPAC (Biopac Systems, Santa Barbara, CA, USA) electromyography device and dominant hand grip strength was simultaneously measured with the hand dynamometer of the same device. The same method was applied for both groups. A single channel was used for the electromyography measurement, which was taken via surface electrodes (Ag-Cl) over the extensor wrist muscle; the ulnar styloid process was chosen for the ground electrode. Electrodes on the muscle were placed about 0.5 cm apart. The measurement was taken in the standard measurement position of the hand dynamometer, with 0° shoulder flexion, 0° shoulder abduction, 90° elbow flexion, and with the forearm in the midline position in the sitting position, during 5 seconds of maximum grip (Figs. 1, 2). In this study total 2 subjects were excluded due to poor quality of EMG recording. The measurement was repeated 3 times and root mean square (RMS) calculations were performed with the MATLAB software.

The mothers included did not have a systemic disorder such as diabetes and had not previously undergone surgery involving the upper extremities. The mothers of children aged 5 years and older who could not transfer and perform their daily care without assistance were included in the study.

Recordings with extreme noise, where the participant misunderstood the directions; or with short grip duration were not considered to increase accuracy and were not included in the study. Subjects with neurological disability due to severe cardiopulmonary diseases, severe hearing loss, history of surgery within the past six months, history of epilepsy, or chronic neurologic diseases were not included in the study. The İstanbul Gelisim University Ethics Committee Chairmanship (Ethics approval certificate No. 2015–23-3) approved the study. Analysis of the data in the study and measurement waves for signal processing analysis was performed with MATLAB. SPSS 22.0 (IBM SPSS, Turkey) software package was used for descriptive statistics and comparisons, and the level of significance was based on a 95% confidence level. Because of the sample size, the Mann-Whitney U-Test was used in the comparison of the two independent groups.

RESULTS

The demographic characteristics of the mothers were compared and difference were noted between the two groups ($p>0.05$). Healthy children's mothers age and disabled children's mothers age were not statistically significant ($p=0.849$) also healthy children and disabled children age were not statistically significant ($p=0.4$). Moreover healthy children mothers and disabled children mothers weight and height were not statistically significant ($p=0.426$ and $p=0.731$ respectively) (Table 1).

For the electromyography measurements, the mean electromyography signal value obtained from the wrist extensor muscle motor points of healthy children's mothers was 0.31 ± 0.08 mV and their mean crude handgrip strength was 28.5 ± 2.08 kg. The mean crude handgrip strength of the mothers of children under rehabilitation was calculated as 7.0 ± 1.1 kg and the mean electromyography signal value of the extensor muscle motor points was 0.17 ± 0.02 mV. A significant difference was noted between mothers of the healthy and disabled children regarding the mean handgrip strength and EMG values ($p<0.001$), with the values in the mothers of the disabled children being notably lower (Table 2).

DISCUSSION

This study was conducted to lay a scientific and clinical foundation for the development of a method for the early detection of cumulative trauma disorders experienced by mothers of disabled children. It was revealed in the findings that the electrical potential of the wrist extensor muscles and crude handgrip strength was significantly lower in mothers with disabled children

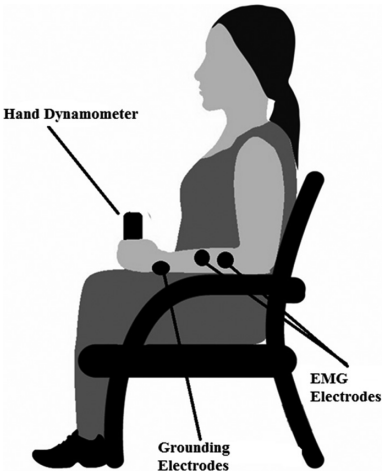
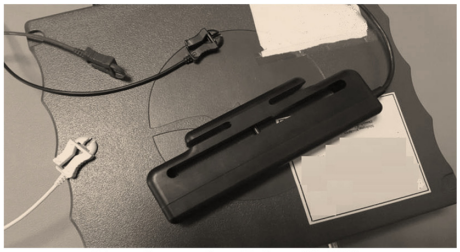


Fig. 1. Measurement position and placement of electrodes.



Biopac Systems, Santa Barbara, CA, USA.

Fig. 2. Surface electromyography measurement device. Biopac Systems, Santa Barbara, CA, USA.

Table 1. Comparison of the characteristics of group cases

Case characteristics	n	Mean ± SD	Median (min–max)	a
Mothers' age (years) Healthy children's mothers	10	34.2 ± 5.8	33.5 (27–45)	
Disabled children's mothers	10	33.3 ± 5.6	34.0 (25–42)	
Children's age (years) Healthy children	10	7.3 ± 1.9	7.0 (5–11)	
Disabled children	10	8.2 ± 2.3	8.0 (5–12)	
Mothers' weight (kg) Healthy children's mothers	10	72.7 ± 11.9	72.5 (50–90)	
Disabled children's mothers	10	69.1 ± 12.3	66.5 (55–90)	
Mothers' height (cm) Healthy children's mothers	10	164.7 ± 4.7	165.0 (157–171)	
Disabled children's mothers	10	165.5 ± 6.3	166.0 (155–175)	

[a]Mann Whitney U test.

Table 2. Hand grip strength and Electromyography (EMG)

Case characteristics	n	Meant ± SD	Median (min–max)	a
Hand Grip (kg) Healthy children's mothers	10	28.5 ± 2.0	28.5 (25.5–32.0)	*
Disabled children's mothers	10	7.0 + 1.1	7.1 (5.5–9.0)	
EMG (mV) Healthy children's mothers	10	0.3 ± 0.08	0.2 (0.2–0.5)	*
Disabled children's mothers	10	0.1 + 0.02	0.1 (0.1–0.2)	

[a]Mann Whitney U test, *Significant.

compared to the control group, revealing early signs of cumulative trauma disorders.

In addition to peculiar socioeconomic burdens, families with disabled children are faced with several health problems to a greater extent compared to families with otherwise normal children. As the disabled child grows older, there is increased stress due to tension in family relations and concerns about the future, resulting in health problems in the mothers of these children and a possible lowering of quality of life[5, 11]. Common health problems reported include increased muscle tension, hypertension, migraine, and eating and digestive system disorders[5]. In the literature, psychological problems have frequently been cited among health problems that mothers with disabled children may experience and it has been stated that conditions such as migraine and stomach problems may be due to the stress experienced[7–10]; however, few studies have addressed associated physical health problems[12, 13].

In the upper extremity region, muscular and skeletal pains frequently occur[6]. Studies have investigated the possibility of cumulative trauma disorders due to frequent use and repetitive movements[13]. Some studies have also shown that muscle loading in the upper extremities increases as arm flexion angle increases[14]. Mothers of disabled children have to repeatedly carry their children who do not have transfer ability, and the arm takes the flexed position during carrying and lifting.

In this study, it was determined that the wrist area of mothers with disabled children was more damaged compared to that

of mothers of non-disabled children and that the activation of wrist extensor muscles and the hand grip strength was lower in these mothers. The relationships between the disabled child's mother grip strength and the normal mother grip strengths depends on various confounding factors, though the child's height, age, types of work and access to food, BMI in particular attenuated the relationships. Published normative data for hand grip strength are available from many countries, and in most cases, data are divided into age and gender subgroups. Analysis of grip strength by gender shows higher grip by males at all ages, and analysis by age group demonstrates a peak of grip strength in the fourth decade and then a gradual decline in grip strength for both genders[15–17]. Similarly in this study a statistically significant (p=0.001*) difference was found between the mothers with disabled children Hand Grip (kg) values and mothers of non-disabled children groups Hand Grip (kg) values. Moreover EMG (mV) Healthy children's mothers values and Disabled children's mothers EMG (mV) values were also statistically significant (p=0.001*). The hand is the most important functional body unit that affects our everyday life, and considering this, we believe that the increased discomfort of mothers with disabled children, who have been exposed to cumulative trauma for a certain period due to the difficulty of care, may cause them to experience difficulties in daily life activities.

In its 2013 charter, UNICEF highlighted the need for special support for families of children with disabilities[18]. Mothers have a critical role in child development. Having a disabled child increases this responsibility both physically and psychologically. Mothers with disabled children live with cumulative trauma disorders in the hand and wrist regions due to the high physical overload. The late detection of these disorders can lead to the advancement of symptoms and increased duration and costs of treatment, and in some cases, disability occurs[19–21].

According to this research, it is necessary to take into account the results of biomechanical studies for the prevention and early detection of musculoskeletal system disorders that are experienced by mothers. To our knowledge, no national and international reports have been published regarding the electrical potential and strength of striated muscles in association with physical health problems in mothers of the disabled. In this pilot study results show that the mothers of children who are dependent in terms of transfer and daily activities may have reduced wrist muscle activation and hand grip strength.

In order to prevent these women from exposure to cumulative trauma, it is necessary to give priority to preventive physiotherapy and rehabilitation for these mothers and to the development of assistive technology devices to reduce the workload associated with performing functional activities for the disabled individual, particularly, transfer activities. It is planned to make the research further by increasing the number of cases and the follow-up period and to develop a special preventive rehabilitation protocol for these mothers. Rehabilitation for mothers with disabled children is a societal activity that should be carried out in conjunction with the ministry of health, universities, municipalities, and research and development teams and believe that these efforts will greatly contribute to the development level of our country.

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