

Assessment of Upper Extremity Motor Function and Its Relation with Fatigue and Cognitive Impairment Among Patients with Multiple Sclerosis

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Abstract:

Background: Multiple Sclerosis (MS) is an unpredictable autoimmune disease that causes damage to the central nervous system including brain, spinal cord and optic nerve. This damage occurs as the body's immune system attack the protective coating called myelin around nerve fibers in the central nervous system. It can affect different aspects of a person's physical and cognitive functioning. Multiple Sclerosis is a complex, chronic disease that necessitates the support of a knowledgeable and concerned team of healthcare providers. This study aimed to assess the relation between upper extremity motor function among patients with MS with fatigue and cognitive impairment. Descriptive correlational research design was conducted on sixty adult patients with the diagnosis of MS who were admitted the MS Outpatient Clinic of El-Hadara Hospital in Alexandria. Four tools were used for collecting data: Tool I: Demographic and clinical data tool, tool II: Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, tool III: Multiple sclerosis Neuropsychological screening questionnaire, and Tool IV: Fatigue assessment tool. Results of the present study revealed that moderate disability of the upper extremity was the most disability level encountered representing more than one third among the study sample (36.7%) , furthermore; more than two third (73.3%) the study sample often having cognitive problems, suffering from severe fatigue (36.7%) and fatigue partially interfered with their quality of life(46.7%). Additionally, there was no significant relation between studied patients' motor function of upper extremity and their cognitive function $p=0.54$. On the other hand, there was a significant relation between studied patients' motor function of upper extremity and fatigue severity level, and effect of fatigue on their quality of life. Accordingly, conducting a comprehensive assessment of patients' upper extremity motor function, cognitive function, and fatigue level among patients with MS is necessary to determine the degree of suffering; this will help the nurses to predict their functional status and the effect of MS on their quality of life.

Keywords-Multiple sclerosis, Upper Extremity Motor Function, Cognitive impairment, Fatigue.

Introduction

Multiple sclerosis (MS) is the most common primary neurological disorder of young adults, especially in Europe and North America. The prevalence of MS has significantly increased all over the world (Börü et al., 2018).

In Egypt, Hashem et al., (2010) study MS prevalence in various

governorates including Alexandria, Assuit, Alkosier and Alkharga Oasis giving prevalence of about 25/100,000 with more familial cases.

Multiple Sclerosis is an unpredictable autoimmune disease that causes damage to the central nervous system including brain, spinal cord and optic nerve. This damage occurs as the

body's immune system attack the protective coating called myelin around nerve fibers in the central nervous system. Myelin is needed for the smooth and rapid transmission of nerve impulses to and from the brain and spinal cord. These attacks cause inflammation that often damages the myelin in patches known as demyelination. Demyelination may cause scarring in the central nervous system resulting in interference in communication between the brain, spinal cord and other parts of the body. Depending on where the damage is varied symptoms and signs of neurological dysfunction can occur. One common initial symptom is optic neuritis (ON), a transient disorder of the optic nerve that often produces blurred vision or short-term blindness. Other sensory symptoms may include numbness, tingling in the hands or feet, cold or burning pain, and dizziness. Motor symptoms may include impaired coordination; imbalance, weakness, intention tremor, and spastic tone. Based on the previous symptoms MS can affect different aspects of a person's physical and cognitive functioning (**Alzheimer Society of Canada 2011 & Ross et al., 2013**).

Upper extremity (UE) dysfunction may be present in up to 80% of individuals with MS, although its importance may be under-recognized relative to walking impairment, which is the hallmark symptom of MS. Upper extremity dysfunction affects independence and can impact the ability to use walking aids. Under-recognition of UE dysfunction may result in limited availability of performance-based and patient self-care (**Kraft et al., 2014**).

Cognitive dysfunction represents about (40–70%) of patients with MS and fatigue represent about (53–92%) which in turn have great impact on independency and quality of life of the individuals with MS (**YozbatNran et al., 2016**). Cognition represents a central human ability, which refers to a wide range of higher order brain functions such as processing speed, memory, attention, executive functions and learning abilities. In MS, several cognitive domains can be affected, and once started; this impairment is often persistent and progressive (**Amato, Portaccio & Goretti, 2010**).

The cognitive core deficits in patients with MS are verbal and visual short-term memory and learning, cognitive flexibility/attention and processing speed/fluidity. As these three cognitive domains are highly relevant for daily functioning, patients experience a significant burden and diminished quality of life due to reduced self-esteem, loss of social activities and contacts, and reduction or even loss of work responsibilities (**Patti, Amato & Trojano, 2009**).

Fatigue is a frequent and debilitating symptom of MS; it can be defined as “a subjective lack of physical and/or mental energy that is perceived by the individual, that can interfere with usual or desired activities”. Fatigue is considered to be one of the main causes of impaired quality of life among patients with MS as it considered to be the single most debilitating symptom, surpassing pain and even physical disability. Fatigue also imposes significant socioeconomic consequence, including loss of work

hours and in some instances loss of employment (Tiffany et al.,2010).

The nurse has a vital role as an educator of patients and their family members. It is very important for the nurses to encourage patients to move out of a passive role and to assume a proactive stance about their disease. By becoming educated, the patient is more likely to feel a sense of empowerment, acceptance, and well-being. The nurse can assist in this process by referring patients to literature, and by explaining the disease process, symptoms, tests, and technical terms. It is important for a nurse to help establish reasonable expectations for proposed treatments, to educate patients in self-care and wellness, and to explain side effects. A nurse's support, advice, education, and expertise can do much to advance MS from an incurable and uncontrollable disease to a manageable problem that is merely a part of patients' lives (Halper &Holland., 2011).

Finally, upper extremities dysfunction, cognitive impairment and fatigue not only affects patients, but also affects their relationship with their families and is a frequent complaint of higher burden for caregivers, therefore upper extremities function , cognitive function and fatigue assessment should be included in the standard clinical evaluation of MS patients, and treatment strategies implemented for those patients .

Aim of the study is:

- To assess the relation between upper extremity motor function of the patients with MS with fatigue and cognitive impairment.
- To assess upper extremity motor function among the patients with multiple sclerosis.

- To assess fatigue level among the patients with multiple sclerosis.
- To assess cognitive impairment among the patients with multiple sclerosis.

Research questions:

- What are the relations between upper extremity motor function, fatigue and cognitive function among the patients with multiple sclerosis?
- What are the relations between upper extremity motor function and fatigue among the patients with multiple sclerosis?
- What are the relations between upper extremity motor function and cognitive function among the patients with multiple sclerosis?

Materials and Method

Materials

Research design:

Descriptive correlational research design was utilized to meet the aim of the present study.

Settings:

The present study was conducted at Multiple Sclerosis Outpatient Clinic of El-Hadara hospital in Alexandria. This outpatient clinic was received patients with MS each Monday weekly.

Subjects

Purposive sample of 60 adults' patients with the diagnosis of multiple sclerosis. were selected based on Epi info7 program that was used to estimate

the sample size using the following parameters:

1. Total population over one year ago at the above-mentioned hospital was 250 patients, 2018- 2019.
2. Expected frequency = 50%
3. Acceptable error = 10%
4. Confidence coefficient = 95%
5. Estimated sample size is = 58 patients with Multiple sclerosis.

Inclusion criteria:

Adult patient with the diagnosis of multiple sclerosis (age 21-60)

Exclusion criteria:

1. Patient's with ongoing relapse attacks.
2. Patient who had any other disorders that affects his/her upper extremity functions as recent surgery in upper extremities, Tennis elbow, Carpal tunnel syndrome, Trapeziometacarpal arthritis etc....
3. Patient who had any other disorders that affect patient cognitive function as other neurological illness as brain tumor etc...
4. Patient who had any other disorders that cause chronic fatigue as cardiac diseases, respiratory diseases or anemia.

Tools: Four tools were used in this study.

Tool I: Demographic and clinical data tool

It was developed by the researchers to obtain baseline data. It consisted of two parts as follows:

Part I: Patient's demographic Characteristics: as age, sex, educational

level, marital status, occupation, and residence area.

Part II: Patient's Clinical Data: as, duration of disease, symptoms felt on multiple sclerosis discovery, previous hospitalization because of MS relapse and names of all current medications.

Tool II: Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire

It adapted by the researchers from the disability of the arm, shoulder and hand (DASH) questionnaire, that was developed by **Hudak et al., (1996)** to provide an instrument that would measure the impact on function of a wide variety of musculoskeletal conditions and injuries affecting the upper limb-the arm, shoulder or hand and to monitor changes in symptoms and function over time.

The DASH involved a 30-items disability/symptom scale concerning the patient's health status during the preceding week. The items asked about the degree of difficulty in performing different physical activities because of the arm, shoulder, or hand problem (21 items), the severity of each of the symptoms of pain, activity-related pain, tingling, weakness and stiffness (5 items), as well as the problem's impact on social activities, work, sleep, and self-image (4 items). Each item had five response options. The total score was ranged from 30 to 150; the mean percentage of the total score was classified as showed at **table (1):**

Table (1): Total Score and percentage of disabilities of the arm, shoulder and hand:

Score	Percentage	Items
0- 30	0 - >20%	There are no disabilities of the arm, shoulder and hands.
30 > 60	20% - > 40%	There are mild disabilities of the arms, shoulders and hands.

60 > 90	40% - > 60%	There are moderate disabilities of the arms, shoulder and hands.
90 > 120	60%- > 80%	There are severe disabilities of the arms, shoulders and hands.
120-150	80% to 100%	Total disabilities of the arms, shoulders and hands.

Tool III: Multiple sclerosis Neuropsychological screening questionnaire

It was adapted by the researchers from MS Neuropsychological screening questionnaire that was developed by **Benedict et al., (2004)**, to assess everyday neuropsychological and

cognitive competence of patients with MS. It consisted of a 15-items for the identification of patients with possible neuropsychological impairment. Scoring based on a 5-point Likert scale, 0 (does not occur) ,1 (Very rarely no problem),2 (Occasionally seldom a problem) ,3 (Quite often interferes with life), and 4 (Very often, very disruptive). The total score was ranged from 0 to 60;

Table (2): illustrated in the mean percentage of the total score was classified as

Score	Percentage	Items
0- >15	0 - >25%	Never or very rarely were having cognitive problems
15> 45	25% - >75	Often were having cognitive problems
45 or more	75% or more	Always were having cognitive problems

Tool IV: Fatigue assessment tool

It consisted of two parts as follows:

Part one: Visual Analog Fatigue Scale (VAFS): It was adopted from **Benjamin., et al (2010)** to assess fatigue severity. It was a horizontal line, 10 cm in length, anchored by word descriptors at each end; left end (No fatigue) and right end (Very severe fatigue). The patient marked on the line the point that he/she felt representing his/her perception and current state. The VAFS score determined by measuring in centimeter from the left-hand end of the line to the point that the patient marked. The measured values illustrated as (0) no fatigue; (1-3cm) mild fatigue, (4-6 cm) moderate fatigue, (7-9 cm) severe fatigue, and (10) very severe fatigue.

Part two: Modified Fatigue Impact Scale (MFIS): It was a modified version of the 40-items that was developed by **Fisk et al., (1994)**, to assess the effects of fatigue on quality of life in patients with chronic diseases, specifically MS. the 40-items FIS was abbreviated into the **21-item** MFIS that contained 9 “physical” items, 10 “cognitive” items, and 2 “psychosocial” items. Patients asked to circle the one number (from a 5-point Likert scoring system) that best indicated how often fatigue affected them during the past 4 weeks. The scale ascended from ‘never’, ‘rarely’, ‘sometimes’, ‘often’ and ‘almost always’ each scored 0–4, respectively. The total score was ranged from 0 to 84, with higher scores indicated a greater impact on quality of life.

Table (3): Illustrated in the mean percentage of the total MFIS score was classified as.

Score	Percentage	Items
Less than 42	Less than 50%	Meant that fatigue never interfere with MS patient's quality of life.
42 > 67	50% - >80 %	Meant that fatigue partially interferes with MS patient's quality of life.
67 and More	80% and More	Meant that fatigue totally interferes with MS patient's quality of life.

Method:

- ✓ An approval from the Ethical Research Committee, Faculty of Nursing, Alexandria University was obtained.
- ✓ An official letter was issued from the Faculty of Nursing, Alexandria University to the study setting to obtain their permission to collect necessary data.
- ✓ An official permission was obtained from the directors and head of the department of the selected hospital setting after explanation the aim of the study.
- ✓ Tool I was developed by the researchers, tool II was adapted from **Hudak et al., (1996)**, tool III was adapted from **Benedict et al., (2004)**, tool IV was adopted from **Benjamin et al., (2010) & Fisk et al., (1994)**. All tools were submitted to five experts in the field of Neuropsychiatry, and Medical Surgical Nursing for content validity and the necessary modifications were carried out accordingly.
- ✓ The reliability of tools was tested by means of Cronbach's alpha. Reliability coefficient for tool I was (0.712), tool II was (0.802), and tool III was (0.906), which meant that all tools were reliable.
- ✓ A pilot study was initially carried out prior to the actual data collection phase on six patients to check clarity, feasibility and applicability of tools and determine obstacles that may be encountered during period of data

collection, accordingly, needed modifications were done.

- ✓ Data collection started at the beginning of August 2019 and ended of March 2019.
- ✓ Every patient was interviewed individually once for 30-45 minutes, using the four tools to collect data related to upper extremity function of patients with multiple sclerosis fatigue and their cognitive function.

Ethical considerations:

- A written informed consent from patients to participate in the study was obtained before data collection and after explanation of the aim of the study.
- Anonymity of the study participants was assured.
- Confidentiality of the collected data was assured.
- Participants' voluntary participation and their right to withdraw from the study at any time were emphasized.

Statistical analysis:

Data were processed and analyzed using PC with statistical package for social science (SPSS ver. 23). Cronbach's alpha reliability test was used to measure the reliability of all tools. Its maximum value is ($\alpha=1.0$) and the minimum accepted value is ($\alpha= 0.7$); below this level the tool would be unreliable. Count (numbers) and percentage from total, used for describing and summarizing bio-sociodemographic data, upper extremity function, fatigue and cognitive function.

Results:

Table (4): Showed frequency and percentage distribution of patients with multiple sclerosis according to their demographic characteristics: it noticed that more than half of the sample (53.4%) were among the age group of (20 - < 30 years). The highest percent of patients (80%) were females, married and coming from urban area (80%,60%, &76.7%) respectively. More than one thirds (40%) of them were highly educated; and about two third of sample were housewives (66.7%).

Table (5): depicted frequency and percentage distribution of patients with multiple sclerosis according to their clinical data, less than half of the sample (46.7%) diagnosed as MS since less than 5 years. It noticed that all the study sample (100%) diagnosed as MS based on clinical examination and history. Double vision was the most (76.7%) encountered symptom among them, followed by disturbed sensation of one or more extremities (46.7%). Corticosteroids were the most used type of medications among the study sample representing (66.7%). Most of the study sample (76.7%) weren't hospitalized because of MS relapse.

Table (6): displayed frequency and percentage distribution of patients with multiple sclerosis according to their upper extremity motor function, revealed that moderate disability of the upper extremity was the most disability level encountered among the study sample representing more than one third (36.7%), followed by no disability of the upper extremity representing about one fourth of them (23.3%).

Table (7): showed Frequency and percentage distribution of patients

with multiple sclerosis according to presence of cognitive problems, it was evident that more than two third (73.3%) of the study sample were often having cognitive problems.

Table (8): illustrated Frequency and percentage distribution of patients with multiple sclerosis according to fatigue severity level and its effect on quality of life, it was found that more than one third (36.7%) of the study sample were suffering from severe fatigue and less than half (46.7) of them had, fatigue partially interfered with their quality of life.

Table (9): denoted relation and correlation between the studied patients' upper extremity motor function and their cognitive function. It was apparent that there was no significant relation as ($Mc= 6.992, P= 04.99$), with no significant correlation coefficient ($r=0.335, p= 0.54$)

Table (10): displayed relation and correlation between the studied patients' upper extremity motor function and fatigue severity level. This table revealed highly statistically significant relation ($Mc= 0.231, P=<0.001^{**}$). Furthermore, there was highly statistically significant correlation coefficient ($r =0.580, p= 0.001^{**}$)

Table (11): Correlation between the studied patients' Upper Extremity motor function, cognitive function and fatigue severity. This table revealed that no significant correlation coefficient was found between upper extremity motor function and cognitive function were ($r=0.335, p= 0.54$), on the other hand, there was highly statistically significant correlation coefficient between upper extremity motor function and fatigue severity ($r =0.580, p= 0.001^{**}$).

Table (4): Frequency and percentage distribution of patients with multiple sclerosis according to their demographic characteristics.

Demographic characteristics	N= 60	
	No	%
Age (years)		
20 –< 30	32	53.4
30 –<40	14	23.3
40 – < 50	8	13.3
50 – 60	6	10.0
Total	60	100
X ± SD	31.63± 9.583	
Sex		
Male	12	20.0
Female	48	80.0
Residence		
Urban	46	76.7
Rural	14	23.3
Level of education		
Illiterate & Read and Write	14	23.3
Primary & Preparatory	4	6.7
Secondary	18	30
Higher education	24	40
Occupation		
Housewife	40	66.7
Businesses	2	3.3
Manual work	8	13.3
Student	10	16.7
Marital status		
Single	24	40.0
Married	36	60.0
Divorced & widow	0	0.0

X ± SD = Mean and standard deviation

Table (5): Frequency and percentage distribution of patients with multiple sclerosis according to their clinical data.

Clinical data	N= 60	
	No	%
Diagnosed as MS since (years)		
less than 5 years	28	46.7
5-<10	22	36.6
10- ≤ 15	10	16.7
*MS diagnosis based on		
Clinical examination and history	60	100
MRI imaging	56	93.3
CSF analysis	5	8.3
*Symptoms felt on MS discovery		
Vision loss	15	25.0
Double vision	46	76.7
Weakness of one or more extremities	20	33.3
Disturbed sensation of one or more extremities	28	46.7
Change in balance	18	30.0
Change in upper extremity coordination	24	40.0

Impaired bladder or bowel control	10	16.7
Brief shocks or tingling with neck movement	7	11.7
Vertigo (spinning dizziness)	4	6.7
What done when patient felt the first symptoms		
Nothing	18	30.0
Visit physician / hospital	40	66.7
Tried to relieve symptoms using popular recipes	2	3.3
*Current Medications		
Don't know	12	20.0
Corticosteroids	40	66.7
Interferon	6	10.0
Vit D	18	30.0
Omega 3	10	16.7
Vit B12	4	6.7
Previous hospitalization because of MS relapse		
No	46	76.7
Less than 5 times	12	20.0
5-10 times	2	3.3

N.B: *More than one answers were allowed

Table (6): Frequency and percentage distribution of patients with multiple sclerosis according to their upper extremity motor function.

Motor function disability level	N= 60	
	No	%
No disability	14	23.3
Mild disability	8	13.3
Moderate disability	22	36.7
Severe disability	6	10.0
Total disability	10	16.7

Table (7): Frequency and percentage distribution of patients with multiple sclerosis according to presence of cognitive problems.

Cognitive impairments	N= 60	
	No	%
Never /rarely had cognitive problems	6	10.0
Often had cognitive problems	44	73.3
Always had cognitive problems	10	16.7

Table (8): Frequency and percentage distribution of patients with multiple sclerosis according to fatigue severity level and its effect on quality of life.

Fatigue severity level	N= 60	
	No	%
Fatigue severity		
No fatigue	6	10.0
Mild fatigue	18	30.0
Moderate fatigue	10	16.6
Severe fatigue	22	36.7
Very severe fatigue	4	6.7
Effects of fatigue on quality of life		
Fatigue does not interfere with patient's quality of life	18	30.0
Fatigue partially interferes with patient's quality of life	28	46.7
Fatigue totally interferes with patient's quality of life	14	23.3

Table (9): Relation and correlation between the studied patients' upper extremity motor function and their cognitive function.

Motor function disability level	Cognitive Function						Test of significance
	Never /rarely having cognitive problems N=6		Often having cognitive problems N= 44		Always having cognitive problems N= 10		
	No	%	No	%	No	%	
▪ No disability	2	33.3	12	27.3	0	0.0	Mc= 6.992 P= 04.99
▪ Mild disability	2	33.3	4	9.1	2	20.0	
▪ Moderate disability	2	33.4	18	40.0	2	20.0	
▪ Severe disability	0	0.0	4	9.0	2	20.0	
▪ Total disability	0	0.0	6	13.6	4	40.0	
Statistical Test Pearson's r	Correlation Coefficient r=0.355						Significance P=0.54

Correlation is significant at the 0.01 level

Mc=Monte carlo test

Table (10): Relation and correlation between the studied patients' motor function of Upper Extremity and fatigue severity.

Motor function disability level	Fatigue level										Test of significance
	No fatigue N=6		Mild fatigue N=18		Moderate fatigue N=10		Severe fatigue N=22		Very severe fatigue N=4		
	No	%	No	%	No	%	No	%	No	%	
▪ No disability	6	100.0	4	22.2	2	20.0	2	9.1	0	0.0	
▪ Mild disability	0	0.0	4	22.2	2	20.0	2	9.1	0	0.0	
▪ Moderate disability	0	0.0	8	44.4	4	40.0	10	45.4	0	0.0	Mc=0.231
▪ Severe disability	0	0.0	0	0.0	0	0.0	4	18.2	0	0.0	P=<0.001*
▪ Total disability	0	0.0	2	11.2	2	20.0	4	18.2	4	100.0	
Statistical Test Pearson's r	Correlation Coefficient r=0.580										Significance P=0.001**

Correlation is significant at the 0.01 level

Mc=Monte carlo test

Table (11): Correlation between the studied patients' Upper Extremity motor function, cognitive function and fatigue severity.

Item	Cognitive function r (p)	Fatigue severity r (p)
Motor function disability level	r = 0.355 P = 0.054	r = 0.580 p = 0.01**
Cognitive function	-	r = 0.338 P = 0.068

** . Correlation is significant at the 0.01 level (2-tailed).

Discussion

Multiple sclerosis is the most common chronic autoimmune demyelinating and inflammatory disease of the central nervous system, affecting both the body and mind (**Bahmani D et al; 2016**). Aging is a significant factor influencing the course of MS; the present study demonstrated that more than half of the sample were among the age group of (20 - < 30 years). This finding was consistent with **Iglesiasa et al; (2015)** who stated that MS mean age of onset ranged

from 20 to 32 years in patients with relapsing-recurrent MS, while onset of progressive forms occurred at older ages (35-39 years).

In relation to sex, the highest percent of patients were females; this may be explained by the differences in the immune system or nervous system between females and males, which might be caused by the effects of gonadal hormones, genetic differences, and different environmental exposures and modern lifestyle in men and women **Harbo, Gold & Tintore,(2013)**. This result was congruent with the results of **Valadkeviciene et al., (2019)** who concluded that, females are expected to be diagnosed with MS two times more often than males.

As regards diagnosis of MS, the study finding noticed that all the studied sample diagnosed as MS based on clinical examination and history. This finding was matched with **Brownlee et al.; (2017)** who illustrated that the diagnosis of MS is based on neurological examination including symptoms and signs. The present findings could be attributed to the fact that clinical reasoning based on facts elicited from symptoms and signs in the history-taking and examination has to be the first step in diagnosis of any diseases.

With reference to symptoms felt when the patients discovered MS, the study result revealed that double vision was the most encountered symptom among the study sample, followed by disturbed sensation of one or more extremities. This may be due to that problems with vision can result from damage to the optic nerve or from a lack of coordination in the eye muscles. Inflammation or demyelination in the optic nerve causes optic neuritis, which is experienced as a temporary loss or disturbance in vision and possibly pain behind the affected eye. In this respect **Etemadifara et al., (2020)** found that, the most frequent first clinical presentation was “optic neuritis” among non-Georgian patients and “double vision” among Georgian patients.

Medications of different classes have been found to be useful in treating MS, the present study portrayed that corticosteroids (CS) were the most used type of medications among the study

sample, it may be explained by that corticosteroids are considered the cornerstone in the management of acute MS relapses as its anti-inflammatory effects. This finding was supported by **Smets et al., (2017)** who reported that targeted immune therapies CS still play a paramount role in the management of MS relapses.

Upper limb dysfunction is a core deficit affecting the patients with MS, the present study illustrated that moderate disability of the upper extremity was the most disability level encountered among the study sample representing about one third of the study sample, this may be due to that the common manifestations of MS include muscle weakness, tremor, sensory deficits, and impaired motor control which in turn affect patient's upper extremities function. In addition to; the sensorimotor network in brain is related with motor dysfunction in the brain, this sensorimotor network has shown functional connectivity decrease among MS patients, which is correlated with upper and lower motor disability. This was in accordance with **Holper et al., (2010)** who reported that 56% of the persons with MS had impairments in structure of have upper extremity and 71% of those had limitations in activities and participation related with hand and arm use.

In relation to cognitive function assessment, the study finding was evident that more than two third of the study sample were often having cognitive problems. This finding may be due to that cognitive impairment may be profound at the late stages of the MS and less than half of the present study sample diagnosed as MS since less than 5 years. This finding was in the same line with **Yalachkov et al., (2019)**, who found that no significant effects were observed for measures of physical disability and

cognitive impairment among the patients with MS.

As regard fatigue severity assessment, the present study illustrated that more than one third of the study sample were suffering from severe fatigue and less than half of the study sample reported that, fatigue partially interfered with their quality of life. This finding may be explained by that fatigue can be related to chemical messengers called cytokines; their levels are higher in patients with MS and may be higher still in patients with fatigue. Another theory is that people with MS may have to use more parts of their brain to do the same task as someone without MS; in essence, they are working harder, otherwise fatigue may be related to reduced electrical transmission of signals in the brain **Braley and Chervin .,(2010)**.

With reference to relation and correlation between the studied patients' Upper Extremity motor function, cognitive function and fatigue severity, the present study illustrated that no significant relation was found between the studied patients' upper extremity motor function and their cognitive function with no significant correlation coefficient, this may be explained by that cognitive function seems to be more closely associated with quality of life than physical impairment. This finding was in the same line with **Chow et al., (2018)** who found no significant correlations between the measures of cognitive function and the overall physical measures including arm and hand function.

With reference to the relation and correlation between the studied patients' upper extremities motor function and fatigue severity, the present study revealed that there was a significant relation, furthermore, there was highly statistically significant correlation

coefficient, this may be explained by that the relation between the upper extremity motor function and fatigue is two way relation as extensive fatigue is a common finding in MS and it severely limits physical activities including upper extremity activities, on the other hand, upper extremity dysfunction can cause dependency, which in turn cause psychological fatigue which incorporates the total body feeling, ranging from tiredness to exhaustion, creating an unrelenting overall condition which interferes with physical and cognitive functions. This was congruent with the result of **Severijns, Van Gel, Feys, (2018)** who concluded that fatigability was associated with perceived fatigue (impact) and daily life upper limb use.

Concerning the relation and correlation between the studied patients' upper extremities motor function and effect of fatigue level on quality of life, the present study portrayed that there were a significant relation and correlation. This may be explained by that MS affect the three-fatigue domains (physical, cognitive and psychosocial), which in turn affect patient's quality of life. This result was in line with **Vister et al., (2017)**, who indicated that increased fatigue and low walking activity levels were significantly associated with increased fall risk and lower quality of life in people with MS.

Finally, the obtained results have put in evidence that multiplicity of MS negative effects exhibit number of life-altering problems such as fatigue, upper limb weakness, alteration of upper extremity fine motor coordination, and impaired cognitive functions thus reducing patient's self-rated quality of life.

Conclusion

From the findings of the present study, it can be concluded that:

Upper limb dysfunction is a core deficit affecting the patients with MS and moderate disability of the upper extremity was the most disability level encountered among more than one third of the study sample. Furthermore, more than two third of the study sample often having cognitive problems, and more than one third of them suffering from severe fatigue which partially interfered with their quality of life.

There was no significant relation between the studied patients' motor function of upper extremity and their cognitive function. On the other hand, there was a significant relation between the studied upper extremity motor function and fatigue severity, in addition to; effect of fatigue on their quality of life.

Recommendations

Based upon the findings of the study, the following recommendations are:

- Conducting a comprehensive assessment of upper extremity motor function, cognitive function, and fatigue is necessary to determine the degree of patients' suffering; this will help nurses to predict their patients' functional status and the effect of MS on their quality of life.
- Additional studies may be needed to explore different upper extremity, cognitive, and fatigue self-management rehabilitative programs.

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