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The Effect of Rehabilitation Exercise Program on Health Status Outcomes of Patients with Multiple Sclerosis

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Abstract: **Multiple sclerosis affects most aspects of life of both the patients and their families. The complexity of the disease, the difficulty in determining the appropriate treatment and a wide range of symptoms call for a comprehensive approach to the patient, which would involve both pharmacology and rehabilitation interventions. Objective: Evaluate the effect of rehabilitation exercise program on health status outcome of patients with multiple sclerosis. Setting: The study was conducted at the Neuropsychiatric Inpatient and outpatient clinics of Al Hadara Alexandria University Hospital. Subjects: A convenience sample of 60 patients determined to have multiple sclerosis. They were sequentially divided into 2 equal groups; the first was the control groups which comprised 30 patients and exposed to routine hospital care only, the second was the study group and comprised 30 patients and they received the rehabilitation exercise program. Tools: Two tools were used Tool I: Kurtzke Expanded Disability Status Scale (EDSS)., Tool II Functional Assessment of Multiple Sclerosis (FAMS) (version4), Results: the study revealed that 63.3%, 60% consecutively) of the patients within control group reported mild overall functional status pre and post exercise rehabilitation program with no statistically significant difference. whereas, 40% of the patients within study group reported moderate overall functional pre exercise rehabilitation program which is increased to 83.3% post exercise rehabilitation program with highly significant difference (FET=4.271, $p < 0.001$). Also highly significant difference was observed between control and study group patients only post application of exercise rehabilitation program (FET= 31.024, $p < 0.001^{*}$). Also it was noticed that: half (50%) of patients within the study group reported moderate mobility pre exercise rehabilitation program which is increased to 63.3% post exercise rehabilitation program with highly significant difference (FET=4.596, p>0.001*). Furthermore, it was observed that, near half (46.7%, 46.7% consecutively) reported worse to moderate symptoms pre exercise rehabilitation program which is changed to better 66.7% post exercise rehabilitation program with highly significant difference (FET=3.576, p>0.001*). Additionally, half of the patients (53.3%) within study group reported that their emotional wellbeing is worse pre exercise rehabilitation program as compared to the results post exercise rehabilitation program as 80% of the study group reported better emotional wellbeing with highly significant. Moreover more than two third (66.7%, 76.7% consecutively) of the patients within study group reported better family and social well-being pre and post exercise rehabilitation program with no statistically significant difference. Conclusion: applying the rehabilitation exercise program had statistically significant improvement of patients' health status outcome. Recommendations: In service training program should be carried out for nurses working in MS unit about the different types of exercises that perform especially to patients with MS**

Keywords: **Rehabilitation Exercise Program, Multiple Sclerosis.**

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I. INTRODUCTION

Multiple sclerosis (MS) is a chronic, inflammatory, neurodegenerative disorder that affects the central nervous system (CNS). Multiple sclerosis is characterized by patchy loss of the myelin sheath that surrounds nerve fibers, visualized on imaging scans as plaques or lesions in the brain and spinal cord (Lublin, 2014; Krieger, Cook, De Nino& Fletcher, 2016). The term of multiple sclerosis refers to two the features of the disease: the multiple areas affected in the brain and spinal cord known as plaques or sclerotic areas causing multiple neurological symptoms over time (Farid, Norasteh, & Hatamian, 2016). According to national statistical records, there is no clear statistical data regarding the incidence of MS in Egypt. According to AL Hadara University Hospital Statistical Medical Annual Records 2018, it was found that 600 patients were diagnosed of MS (Al Hadara University Hospital, 2018).

In most patients, MS is initially characterized by episodes of reversible neurological deficits, which is often followed by progressive neurological deterioration over time (Goldenberg, 2017). Patients are grouped into four major categories based on the course of disease: relapsing remitting MS (RRMS), primary progressive MS (PPMS), secondary progressive MS (SPMS) and progressive relapsing MS (PRMS). The following 2 subgroups are sometimes included in RRMS: Clinically isolated syndrome (CIS): A single episode of neurologic symptoms and benign MS: MS with almost complete remission between relapses (National Multiple Sclerosis Society, 2019; Elshaer, Kallab, Alqrinawi, & Abdelsalam, 2018). Relapsing remitting MS is the most common form, affecting about 85% of patients; it is marked by flare-ups (relapses or exacerbations) of symptoms followed by periods of remission. PPMS affect approximately 10% of patients; symptoms continue to worsen gradually from the beginning. There are no relapses or remissions (Goldenberg, 2017; Harrison, 2014). SPMS begins as RRMS and develops into a steadier progression of disability without relapses. It affects 15% of cases. PRMS is a rare form, affecting fewer than 5% of patients. It is characterized by steadily progressing disease from the beginning and occasional exacerbations or relapse along the way (Goldenberg, 2017; National Multiple Sclerosis Society, 2015).

The etiology of MS still remains unclear. A combination of environmental and genetic factors leads to autoimmune reactions against CNS structures which in turn result in CNS tissue damage and neurological impairment (Dendrou, Fugger& Friese, 2015). As a result of these problems different symptoms and signs may occur depend on the location of demyelination and extent of the lesion, such as visual impairment, dysarthria and dysphagia, numbness or tingling, weakness, dizziness and vertigo. In addition, sexual problems, cognitive problems, bowel and bladder problems, walking difficulties, spasticity, paresis, coordination and balance impairment, ataxia, pain, as well as sensory impairment (Hassanpour& Jivad, 2014; Ghasemi, Razavi, & Nikzad, 2017).

It has been suggested that rehabilitation, is a fundamental part of neurological care, as it is considered the only approach which can improve the limitations in activity and restrictions in social participation of people with MS (Szilasiova, Gdovinova, & Dijk, 2011). Rehabilitation can be defined as an active process of education and enablement, which is focused on the appropriate management of disability and minimizing limitation of handicap, with the goal of achieving full recovery (Zahmatkeshan& Delaviz, 2017) . The introduction of exercise training program as aerobic, balance, resistance, and range of motion exercises for MS patients have beneficial effects on the various processes of MS as on muscular strength, aerobic capacity and ambulatory performance, and may improve fatigue, gait, balance and QoL (Motl & Pilutti, 2012). Considering these benefits, rehabilitation exercise program can potentially play an important role in managing MS relapses and facilitating the recovery process (eg, reducing the risk of long-term disability, providing strategies to manage residual disabilities, improving function toward prerelapse level) (Beer, Khan& Kesselring, 2012; Asano, Raszewski& Finlayson, 2014).

Rehabilitation exercise interventions should be considered early for maintaining functional capacity and reducing risk for losing important abilities or independence. Actual recommendations states that rehabilitation should begin as soon as impairment is noticed by patient, for example gait difficulties, hand clumsiness, attention or memory deficits, urinary troubles, visual deficits, speaking difficulties, and or excessive tiredness (Stanescu & Dogaru, 2014). For many years, physicians advised newly diagnosed persons with MS to avoid any physical activity and exercise. But now, it is believe that regular exercise and training is a possible solution during disease period by limiting the deconditioning process and

achieving an optimal level of patient activity, functions and many physical and mental health benefits without any concern about a triggering onset or exacerbation of disease symptoms or relapse, so the aim of the study to identify the effect of rehabilitation exercise program on health outcome of patient with MS (Motl, 2013).

II. MATERIALS AND METHOD

- **MATERIALS**

Research Design:

A Quasi experimental research design was utilized to fulfill the aim of this study.

Setting:

- The present study was conducted at the Neuropsychiatric Inpatient and outpatient clinics of Al Hadara Alexandria University Hospital.

Subjects:

A convenience sample of 60 adult's patients admitted to the above mentioned setting and diagnosed with multiple sclerosis were recruited in this study. The study subjects divided randomly into two equal groups; study and control group (35 for each group), the study group received self- care practice guidelines and the control group exposed to routine hospital care only.

The study sample was estimated based on Epi info -7 program using the following parameters;

1- Population size: 157

2- Expected frequency: 50%

3- Acceptable error: 10%

4- Confidence coefficient: 95%

5- Minimum sample size: 60

Inclusion criteria: The patients were selected according to the following criteria (Razieh et al., 2016; Zahmatkeshan & Delaviz, 2017; Nilsagård, 2012):

- Age: 18-60 years.
- Patient confirmed with diagnosis of multiple sclerosis
- Able to communicate verbally, and able to follow the instructions.
- Patients with relapsing remitting multiple sclerosis not in either secondary or primary multiple sclerosis.
- Didn't participate in regular exercise activities in the last two months.
- Have no ongoing exacerbation of multiple sclerosis.

Study Tools: -

Two tools were used for data collection:

Tool I:

Kurtzke Expanded Disability Status Scale (EDSS) (United States Department of Veteran's Affairs, 2018)**:**

It was developed by Dr. John Kurtzke in 1950 to measure the disability status of people with multiple sclerosis (MS) and monitoring changes in the level of disability over time. It consists of 10 scales that created an objective approach to quantify the functional abilities level for diagnostic assessment of MS.

- **Scoring system of Kurtzke Expanded Disability Status Scale (EDSS):** The EDSS provides a total score on a scale that ranges from zero to ten.

The first level 1.0 to 4.5 refer to people with high degree mobility

The subsequent levels 5.0 to 9.5 refer to the loss of ambulatory ability.

This tool is consists of two additional parts as follows:

- **Part I: Socio demographic data:** It was used to measure demographic characteristics of MS patients. Included: age, gender, level of education, marital status, occupation and area of residence.

- **Part II: Patients Clinical Data:** Clinical data was collected from patients medical records, and covered the following: Past and present medical history such as presence of: cardiovascular disease, epilepsy, psychological disease, visual impairment, orthopedic disease, diabetes mellitus, Parkinson's and Alzheimer's disease and date of discharge

Tool II:

Functional Assessment of Multiple Sclerosis (FAMS) (version4) (Sørensen et al., 2011; Ryan, 2018)**:** This tool developed by David Cella in 1996 obtain self-report health-related quality-of-life instrument for people with multiple sclerosis it consists of 58 items (44 of which are scored) in six quality of life domains.

- Mobility composed of 7 items
- Symptoms composed of 7 items
- Emotional Well-being composed of 7 items
- General Contentment composed of 7 items
- Thinking/Fatigue composed of 9 items
- Family/Social Well-being composed of 7 items

* Additional Concerns subscale of 15 items consists of items that fall outside the six domains but may provide further clinical value. (e.g., I am bothered by side effects of treatment….)

Scoring system: Persons completing the tool answer items on a 5-point Likert scale:

Zero = Not at all

1 = A little bit

2 = Some what

3= Quite a bit

4= Very much

- **Method**

The study was accomplished as follows:

1. Written Approval:

- An official letter was issued from the Faculty of Nursing Alexandria University to the hospital director, departments' heads and head nurses of the departments' conduct the study after explanation of the study aims

- Verbal explanation was performed by the researcher to medical and nursing staff about the purpose of the study, time of data collection in order to obtain approval to carry out the study.

2. Tool development:

Tool I: Kurtzke Expanded Disability Status Scale (EDSS): It was adopted from Dr. John Kurtzke to measure the disability status of people with multiple sclerosis and monitoring changes in the level of disability over time. It is consisted of 10 scales that were created an objective approach to quantify the functional abilities level for diagnostic assessment of MS.

Tool II: Functional Assessment of Multiple Sclerosis (FAMS) (version4): This tool adopted from David Cella to obtain self-report health-related quality-of-life instrument for people with multiple sclerosis. It is consists of 58 items (44 of which are scored) in six quality of life domains.

Additionally: Socio-demographic and clinical data interview schedule; this was developed by the researcher.

3. Testing of content validity:

The adopted tools I and II was tested for content validity by a jury of 5 experts in the field of Medical Surgical Nursing. Every jury member was informed about the aim and methods of the study. Comments and suggestions of the jury were considered and the tools were modified accordingly.

4. Reliability testing

The reliability of assessment tool were tested using Cornbrash's` alpha. The tool for the study was applied to 6 patients. Reliability coefficient value was 0.919.

5. Pilot study:

- A pilot study was carried out before starting the data collection. It was applied on 10% out of the sample patients diagnosed with MS who fulfilled the inclusion criteria.

- The pilot study was done to test feasibility, clarity and applicability of tools, ascertain the relevance of the tool, and detect any problem peculiar to the statements clarity that might interfere with the process of data collection and estimate the time needed to complete the interview schedule. Following this pilot study the necessary modification were done.

The study sample were randomly assigned and divided attentively into two equal groups, a control & experimental studied group.

6. Data collection:

- After securing administrative approval, data collection was initiated covering a period of 5 months (from June 2019 to October 2019).

- Socio-demographic and clinical data was obtained from all patients who participated in this study on the first day of contact with the researcher.

- Patients in the control group (group II) were exposed only to routine hospital care in the ward by nursing staff group- Patients in the control group (group II) were exposed only to routine hospital care in the ward by nursing staff group.

- Patients in the study group (group I) were exposed exercise based rehabilitation program, which was carried out in the following four phases:

a. Phase I: Assessment phase:

- An initial assessment to all patients (study and control groups) was carried out before implementing the rehabilitation exercise program. It was aimed to collect baseline patients' data, health history, assess the functional abilities level using tool I & II.

- Each patient was interviewed individually by the researcher using tool I & II within approximately 45-60 minutes, according to patients' response, after explaining the purpose of the study.

b. Phase II: Planning phase:

- Based on the data collected from the assessment phase and review of related literature, the program goals, priorities contents, expected outcomes were developed by the researcher according to the individual needs and problems. In

addition illustrated colored booklet was developed by the researcher and distributed to each patient in the implementation phase.

- The neuropsychiatric clinic provided the researcher with suitable room at the multiple sclerosis outpatient clinics for meeting the patients and implementing the rehabilitation program>

c. Phase III: Developmental and implementation phase:

The rehabilitation exercises program was developed by the researcher based on review of related literature **it included 2 parts: didactic and practicum part.**

- **Didactic part:**

- It was consisted of verbal instructions about: general purpose of the rehabilitation exercise, types, frequency, duration & specific purpose of each exercise applied, and precautions during the exercises for a period of (30 to 45 minutes).

- A booklet was distributed among the studied group. It was written in a simple Arabic language and supplemented by photos and illustrations to help the patient's understanding of the content.

- **Practicum part:(Patients Exercise Training)**

- A Patient exercise program included a group of exercises that was formulated using demonstration and redemonstration. The exercises was organized according to a feasible learning sequence (from easy to difficult) to enhance patients' practice. Patients were asked to redemonstrate the exercises until the researcher was confirmed that the patient matched the required skills.

- The exercise program was conducted for duration of time 12 weeks. Three sessions for three non-consecutive days each week. The studied patients (group I) were divided into 6 groups (5 patients/ session) to facilitate conduction of the program. Each session takes about 20-60 minutes and appropriate exercise duration intensity, and frequency was applied through the tailored exercise program and according to patient tolerance.

Every session included 3 phases according to the designed table. (Motl & Pilutti, 2012; Padgett & Kasser, 2013; Sandoval, 2013; Jose, 2014; Westerdahl, Wittrin, Kånåhols, Gunnarsson & Nilsagård, 2015)

1st phase (initial phase):

- **Stretching and warming up**

10-20 times in the form of hurrying in place and stretching of upper and lower extremities

Duration and intensity: Moderate intensity 5-10 minutes in each session

2nd phase (central phase):

1. Aerobic training exercises (Endurance or Interval):

Upper limb endurance (Lifting low weight):

Upper limb exercise in the form of lifting free weights Repetitive lifting of free weights was done to exercise the upper limbs. First maximal repetition was determined at the beginning of every week as a standard for improvement. Fifteen repetitions were performed of weights that were determined according to patient's tolerance. Increased weights were used by the start of each new week.

• Duration: 10-15 minutes weekly in each session

• Repetition: 8-15repetitions were performed of weights that were determined according to patient's tolerance. Increased weights were used by the start of each new week.

Measuring vital signs before starting exercise and monitor patient heart rate

Measuring vital signs 5 minutes post exercise

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Lower limb endurance (Walking or stationary cycling if possible)

• Duration: 15 minutes weekly in each session

• Repetition: 8-15 repetitions were performed

Intensity: Moderate Intensity of training was applied to reach 60-80% of maximal heart rate (MHR=220-age) but was modified according to patient's tolerance.

Distance: according to patients` tolerance

2. Range of motion exercises

2.1 Duration and intensity: moderate intensity 20-30 minutes in each session

2.2 The frequency was repeated 8-15 times

3. Resistance training:

Pushing exercises by using training machine or free weights. If training machine were unavailable alternatives include the use of elastic bands and water bottle or use body weight as load.

- Lower limb muscle strength: Moderate intensity with 15-20 minutes weekly in each session
- Upper limb muscle strength: Moderate intensity with 15- 20 minutes weekly in each session
- The frequency was repeated 8-15 times

4. Stretching and balance exercises

- Duration from 10-15 minutes
- The frequency was repeated 8-10 times

5. Breathing retraining exercise

5.1 Pursed lip breathing: 5 minutes in each session

5.2 Diaphragmatic breathing exercises: 5 minutes in each session

5.3 The frequency was repeated 4-7 times

3rd phase (final phase):

Stretching and relaxation exercises

- In the form of stretching of upper and lower extremities and breathing exercises
- 10-20 repetition
- Duration and intensity: Moderate intensity 5-10miutes in each session.

Phase IV: evaluation phase:

- Multiple sclerosis patients were re-evaluated by the researcher using tools II, and III after the implementation of the MS rehabilitation program to determine the effectiveness of rehabilitation program on their health status outcome.

▪ **Indentations and Equations**

Statistical Analysis

A- After the data were collected, they were coded and transferred into special design formats, so as to be suitable for computer feeding. Following data entry, checking and verification processes were carried out to avoid errors during data entry. Data was computed and statistically analyzed using the Statistical Package for Social Sciences "SPSS" software version 20.

B- Descriptive statistics

- Count (numbers) and percentage, used for describing and summarizing qualitative data.
- Mean median and standard deviation, used for describing and summarizing quantitative data.
- Minimum- Maximum used for presenting non parametric quantitative data.

B-Analytical statistics

- After the data were collected, they were coded and transferred into special design formats, so as to be suitable for computer feeding. Following data entry, checking and verification processes were carried out to avoid errors during data entry. Data was computed and statistically analyzed using the Statistical Package for Social Sciences "SPSS" software version 18. Count (numbers) and percentage, used for describing and summarizing qualitative data. Mean median and standard deviation, used for describing and summarizing quantitative data. Minimum- Maximum, used for presenting non parametric quantitative data and the level of significance selected for this study was P equal to or less than 0.0

The used tests are as following:

1. **Cronbach's alpha reliability test:** It was used to measure the reliability of the developed tools. Its maximum value is (α=1.0) and the minimum accepted value is (α= 0.7); below this level the tool would be unreliable
2. **Chi square test:** For categorical variables, to compare between different groups.
3. **Fisher's exact test:** test was used for comparison between the distributions of two qualitative variables whenever the Chi-Square (χ2) test was not appropriate (> 20% of the expected cells has expected count < 5)
4. **Marginal homogeneity test:** Used to analyze the significance between the different stages
5. **Student t- test:** It used for normally distributed quantitative variables, to compare between two studied groups
6. **Paired t- test:** It used for normally distributed quantitative variables, to compare between two periods

III. RESULTS

Table (1): Shows the frequency distribution of the study and control groups according to their socio-demographic characteristics. As regard age, it can be noticed that the highest percentage (46.7%) was among the age group of (>30 to 40 years), in both control and studied group. Regarding the patient's sex, the result reveals that the majority (76.7%) of patients were females, distributed as 80% in the control group patients and 73.3% in the study group patients. In relation to the level of education, it was observed that more than half (60%, 56.7% respectively) in both control and studied group patients was at university level. Concerning occupation, it was illustrated that more than half (53.3%) in the control group patients were house wives while less than half (46.7%) in the studied group was worker. As regards the marital status, around two thirds of both control group and study groups patients were married representing (66.7%). Regarding place of residence, it was observed that the majority (93.3, 86.7% respectively) in both control and were living in urban area. The difference was not statistically significant among all characteristics.

Figure (1): Shows comparison between the two studied groups according to expanded disability status scale. The table shows that, vast majority (100%, 96.7% consecutively) of the patients within control group had high degree mobility pre and post exercise rehabilitation program. Also, on the other hand, vast majority (100%) of the patients within study group had high degree mobility pre and post exercise rehabilitation program.

Table (2): Shows Comparison between control and studied group regarding overall functional assessment domains pre and post rehabilitation exercise program. Concerning mobility domain, the table illustrates that more than two thirds of the control group had reported worse mobility either pre or post exercise rehabilitation program (66.7%, 76.7% consecutively). On the other hand, 60% the studied group had reported moderate mobility pre exercise rehabilitation program, which had been changed to moderate 63.3% post exercise rehabilitation program with highly significant difference. Highly significant difference was observed between control and studied group post exercise rehabilitation

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program (p>0.001*). (FET=4.596, p<0.001*). Also highly significant difference was observed between control and study group patients only post application of exercise rehabilitation program (FET= 39.538, p<0.001*).

As regards symptoms domain, the table reveals that, half (53.3%, 50% consecutively) of the control group had reported that their symptoms were worse pre and post exercise rehabilitation program. Otherwise, near half (46.7%) of the studied group had reported worse to moderate symptoms pre exercise rehabilitation program, which had been changed to better 66.7% post exercise rehabilitation program. Highly significant difference was observed between control and studied group post exercise rehabilitation program (p<0.001*).

Regarding emotional well-being domain, the table represents that, more than two third (70%) of the control group had reported that their emotional wellbeing was worse pre and post exercise rehabilitation program. On the other side, more than half of the patients (53.3%) of the studied group had reported that their emotional wellbeing was worse pre exercise rehabilitation program, which had been changed to moderate 80% post exercise rehabilitation program. Highly significant difference was observed between control and studied group post exercise rehabilitation program (p<0.001*).

In relation to social /family well-being domain, the patients within the control group had reported better family and social well-being pre and post exercise rehabilitation program (63.3%, 66.7% consecutively). Also it was noticed that, more than two third (66.7%, 76.7% consecutively) of the studied group had reported better family and social well-being pre and post exercise rehabilitation program with no statistically significant difference.

Regarding overall functional status, it was noticed that the patients within the control group had reported that their overall functional status was worse pre and post exercise rehabilitation program (63.3%, 60% consecutively). Whereas, less than half (40%) of the studied group had reported that their overall functional status was moderate pre exercise rehabilitation program, which had been increased to 83.3% post exercise rehabilitation program. Highly significant difference was observed between control and studied group post exercise rehabilitation program (p<0.001*).

Table (3): Shows statistical relation between overall functional assessment and socio-demographic data. The table illustrates that, there was statistical significant relation between patients level of education and their overall functional status pre exercise rehabilitation program (^{FE}P=14.401*, p=0.001*). As, the vast majority (100 %) of the patients who were at university had reported their overall functional status was better as compared to other level of educations pre exercise rehabilitation program, with no statistical significant relation post exercise rehabilitation program. Also, the table conveys that, there was statistical significant relation between patient's occupation and their overall functional status pre and post exercise rehabilitation program. Majority (91.7%, 100% consecutively) of the working patients had reported that their overall functional status was better as compared to other occupations pre and post exercise rehabilitation program (^{FE}P=15.904*, ^{FE}P=5.901 respectively).

Table (1): Frequency distribution of patients with multiple sclerosis of both control and study group according to socio-demographic characteristics

Socio demographic	Study (n = 30)		Control (n = 30)		Total (n = 60)		χ^2	p
	No.	%	No.	%	No.	%		
Patient's age								
20 to 30	9	30.0	10	33.3	19	31.7	1.062	^{MC}p= 1.000
> 30 to 40	14	46.7	14	46.7	28	46.7		
> 40 to 50	6	20.0	6	20.0	12	20		
> 50 to 60	1	3.3	0	0.0	1	1.7		
Gender								
Male	8	26.7	6	20.0	14	23.3	0.373	0.542
Female	22	73.3	24	80.0	46	76.7		
Level of education								
Primary	2	6.7	1	3.3	3	5	1.370	^{MC}p= 0.763
Secondary	7	23.3	9	30.0	16	26.7		
University	17	56.7	18	60.0	35	58.3		
Read & write	4	13.3	2	6.7	6	10		

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Occupation								
Worker	14	46.7	7	23.3	21	35		
House wife	13	43.3	16	53.3	29	48.3	4.244	0.120
not work	3	10.0	7	23.3	10	16.7		
Marital status								
Single	9	30.0	8	26.7	17	28.3		
Married	20	66.7	20	66.7	40	66.7	1.265	$^{MC}p=$ 1.000
Divorced	0	0.0	1	3.3	1	1.7		
Widow	1	3.3	1	3.3	2	3.3		
Area of residence								
Rural	4	13.3	2	6.7	6	10	0.741	$^{FE}p=$ 0.671
Urban	26	86.7	28	93.3	54	90		

n: number of the studied patients

X^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact**

p: p value for comparing between the studied group

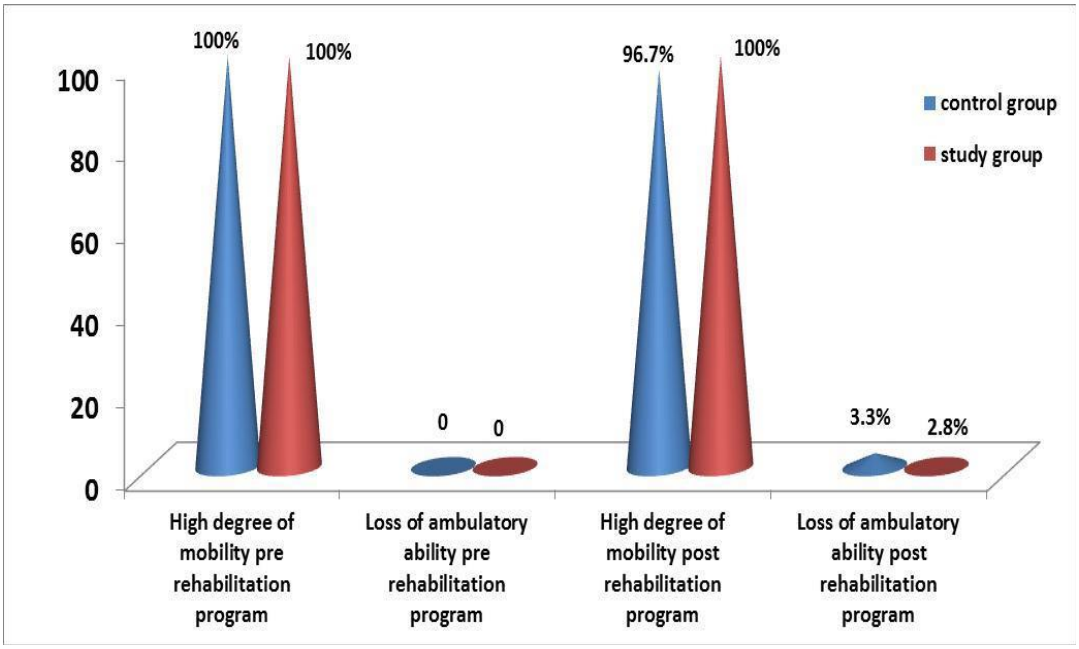

Figure (1): Comparison between the two studied groups according to expanded disability status scale (EDSS)

- The first level 1.0 to 4.5 refers to people with high degree mobility

- The subsequent level 5.0 to 9.5 refers to the loss of ambulatory ability.

- 10 refer to death due to MS.

Table (2): Comparison between control and study group patients with multiple sclerosis regarding overall functional assessment domains pre and post rehabilitation exercise program

Functional domains	Control (n = 30)				$^{MH}p_0$	Study (n = 30)				$^{MH}p_0$	χ^2 (p_1)	χ^2 p_2
	Pre		Post			Pre		Post				
	No.	%	No.	%		No.	%	No.	%			
Mobility												
Mild (<33.3%)	20	66.7	23	76.7		12	40.0	0	0.0			
Moderate (33.3% – 66.6%)	10	33.3	7	23.3	1.134	18	60.0	19	63.3	4.426*	4.286*	39.538*
Better (>66.6%)	0	0.0	0	0.0	(0.257)	0	0.0	11	36.7	(<0.001*)	(0.038*)	(<0.001*)

Symptoms												
Mild (<33.3%)	16	53.3	15	50.0	1.147 (0.251)	14	46.7	5	16.7	3.576* (<0.001*)	0.603 (MCp= 0.850)	15.667* (MCp= <0.001*)
Moderate (33.3% – 66.6%)	13	43.3	10	33.3		14	46.7	5	16.7			
Better (>66.6%)	1	3.3	5	16.7		2	6.7	20	66.7			
Emotional well being												
Mild (<33.3%)	21	70.0	21	70.0	0.00 (1.000)	16	53.3	0	0.0	4.200* (<0.001*)	2.838 (MCp= 0.368)	37.028* (MCp= <0.001*)
Moderate (33.3% – 66.6%)	7	23.3	7	23.3		13	43.3	24	80.0			
Better (>66.6%)	2	6.7	2	6.7		1	3.3	6	20.0			
General contentment												
Mild (<33.3%)	13	43.3	13	43.3	0.447 (0.655)	11	36.7	3	10.0	2.949* (0.003*)	0.567 (0.753)	12.450* (0.002*)
Moderate (33.3% – 66.6%)	13	43.3	11	36.7		13	43.3	9	30.0			
Better (>66.6%)	4	13.3	6	20.0		6	20.0	18	60.0			
Thinking and fatigue												
Mild (<33.3%)	20	66.7	18	60.0	1.508 (0.132)	19	63.3	9	30.0	2.271* (0.023*)	3.119 (0.239)	5.723 (0.057)
Moderate (33.3% – 66.6%)	9	30.0	8	26.7		6	20.0	12	40.0			
Better (>66.6%)	1	3.3	4	13.3		5	16.7	9	30.0			
Family/social well-being												
Mild (<33.3%)	0	0.0	0	0.0	2.449 (0.414)	0	0.0	0	0.0	3.317 (0.366)	0.635 (0.426)	1.270 (0.260)
Moderate (33.3% – 66.6%)	13	43.3	1	36.7		10	33.3	7	23.3			
Better (>66.6%)	17	56.7	19	63.3		20	66.7	23	76.7			
Additional concerns												
Mild (<33.3%)	11	36.7	12	40.0	0.277 (0.782)	7	23.3	1	3.3	2.496* (0.013*)	1.270 (0.260)	13.917* (MCp= <0.001*)
Moderate (33.3% – 66.6%)	19	63.3	18	60.0		23	76.7	26	86.7			
Better (>66.6%)	0	0.0	0	0.0		0	0.0	3	10.0			
Overall score												
Mild (<33.3%)	19	63.3	18	60.0	0.302 (0.763)	18	60.0	0	0.0	4.271* (<0.001*)	0.071 (0.791)	31.024* (MCp <0.001*)
Moderate (33.3% – 66.6%)	11	36.7	12	40.0		12	40.0	25	83.3			
Better (>66.6%)	0	0.0	0	0.0		0	0.0	5	16.7			

n: number of the studied patients

χ^2: **Chi square test** MC: **Monte Carlo** **MH: Marginal Homogeneity Test**

p_0: p value for comparing between **before** and **after** in each group

p_1: p value for comparing between **Study** and **Control** in **before period**

p_2: p value for comparing between **Study** and **Control** in **after period**

*: Statistically significant at $p \leq 0.05$

Table (3): Statistical relation between overall functional assessment and socio-demographic data in study group patients pre and post rehabilitation exercise program (n = 30)

Socio demographic	Overall functional assessment							
	Pre program				Post program			
	Mild functional status (n = 18)		Moderate functional status (n = 12)		Moderate functional status (n = 25)		Better functional status (n = 5)	
	No.	%	No.	%	No.	%	No.	%
Patient's age								
20 to 30	5	27.8	4	33.3	9	36.0	0	0.0
> 30 to 40	10	55.6	4	33.3	9	36.0	5	100.0
> 40 to 50	2	11.1	4	33.3	6	24.0	0	0.0
> 50 to 60	1	5.6	0	0.0	1	4.0	0	0.0
χ^2(MCp)	3.186 (0.363)				5.712 (0.111)			

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Gender								
Male	7	38.9	1	8.3	7	28.0	1	20.0
Female	11	61.1	11	91.7	18	72.0	4	80.0
χ^2(^{FE}p)	3.438 (0.099)				0.136 (1.000)			
Level of education								
Primary	2	11.1	0	0.0	2	8.0	0	0.0
Secondary	7	38.9	0	0.0	7	28.0	0	0.0
University	5	27.8	12	100.0	12	48.0	5	100.0
Read & write	4	22.2	0	0.0	4	16.0	0	0.0
χ^2(^{MC}p)	14.401* (<0.001*)				3.225 (0.382)			
Occupation								
Worker	3	16.7	11	91.7	9	36.0	5	100.0
House wife	12	66.7	1	8.3	13	52.0	0	0.0
not work	3	16.7	0	0.0	3	12.0	0	0.0
χ^2(^{MC}p)	15.904* (<0.001*)				5.901* (0.040*)			
Marital status								
Single	6	33.3	3	25.0	7	28.0	2	40.0
Married	11	61.1	9	75.0	17	68.0	3	60.0
Widow	1	5.6	0	0.0	1	4.0	0	0.0
χ^2(^{MC}p)	1.013 (0.815)				0.970 (0.703)			
Area of residence								
Rural	2	11.1	2	16.7	3	12.0	1	20.0
Urban	16	88.9	10	83.3	22	88.0	4	80.0
χ^2(^{FE}p)	0.192 (1.000)				0.231 (0.538)			

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact**

*: Statistically significant at $p \leq 0.05$

IV. DISCUSSION

Multiple sclerosis is an inflammatory autoimmune disease characterized by demyelinating lesions in the central nervous system, which has a slow and progressive course with periods of remission and exacerbation of the neurologic symptoms. It can affect motor, sensory, cerebellar, cognitive, sphincter and spinal cord areas. During the course of the disease a wide range of functional impairments and disabilities may develop which lead to psycho-social handicap and reduction of quality of life. (Figueiredo, Polachini & Prado, 2016)

Participation in physical activity, particularly exercise training, has increasingly been recommended for patients with multiple sclerosis to manage symptoms, restore function, optimize quality of life, promote wellness, and boost participation in activities of daily living. Thus, exercise can be a beneficial rehabilitation approach for addressing the multifaceted aspects of multiple sclerosis. (Motl et al., 2017) Therefore, this study was carried out to evaluate the effect of rehabilitation exercise program on health status outcome of patients with multiple sclerosis. Discussion of the study results will be presented within the following:

Concerning socio-demographic data of the studied patients;

In relation to patient's age, the present study showed that, most of the patients' age ranged from 31 -to 40 years old. The causes behind many clinicians consider MS as an exclusively adult-onset disease which commonly diagnosed between the ages of 20 and 40 years old in my opinion might be related to exposure of young adult mostly to stressful situations and environmental factors like bad eating habits as young age eating fast food which contain Hydrogenated fats also lack of vitamin D deficiency (vitamin D may be derived from both sunlight and diet), also cigarettes smoking and infection exposure all these considered risk factors for occurring MS. This finding is in line with (Zahmatkeshan & Delaviz, 2017) in their study illustrated that, the majority of patients were at mean age 36 years old. Also, (Pazokian, Shanan, Zakerimoghadam, Mehran & Yekefallah, 2013) in their study showed that, the majority of patients mean age were at 35 years old.

According to gender, the present study revealed that, the majority of studied patients were female. The fact that Autoimmune diseases (cell or antibody mediated), including MS, occur two to three times in women than men was explained by National Multiple Sclerosis Society whose suggested that, hormonal changes during menstruation, contraception, pregnancy, and menopause and lower levels of testosterone may play a significant role in determining susceptibility to MS.

This finding is in line with (Pazokian et al. 2013; Zahmatkeshan & Delaviz 2017) who revealed that, more than two third of the patients were female and less than half were male. Also, (Mikuľáková, Klímová, Kendrová, Gajdoš & Chmelík, 2018), in their study stated that, the majority of study subjects were females and less than half of them were males. Additionally, (Cruz-Orengo et al., 2014) found that females susceptible to MS produce higher levels of a blood vessel receptor protein, S1PR2, than males and that the protein is present at even higher levels in the brain areas that MS typically damages.

Considering level of education, the present study showed that, more than half of studied patients with high educational level. This study finding is supported by (Rashvand, Abtahi, Eshgh, Pouraram &Farvid, 2016; Lutz, Kersten & Haas, 2017) who revealed that majority of studied patients were university education On the other hand, these findings are in contrast to (Radmehr, Meghdadi, Bahmanzadeh &Sabbagh, 2015) ; Moore et al. (2013) who revealed that, majority of studied patients were below high educational level.

Regarding occupation, the study showed that, highiest percentage of the studied patients were house wives. This finding is coherent with (Moore et al., 2013; Radmehr et al., 2015).

In relation to residence and marital status, the findings of this study illustrated that, the highest percentage of MS from urban areas and were married. This finding is indeed with the recent studies by (Rezaali, S., Khalilnezhad, A., Moghadasi, A., Chaibakhsh,S., Sahraian, 2013; Albuquerque et al., 2015; Costa et al., 2017). These findings can be attributed to the fact that, marriage usually increases the responsibilities as well as a life stressor in this period of life which may lead to increased risk for MS due to stress. Also, living in urban areas leads to more exposure to environmental hazards, unhealthy diet and more pollution exposure than rural regions.

- **As regard Expanded Disability Status Scale (EDSS) of studied patients;**

Monitoring the impact of MS on functional status and quality of life is a continuous process, therefore, EDSS was one of many important scales used to assess functional and physical disability of patients with MS. Regarding EDSS, the present study finding revealed that all of the study group patients showed high degree of mobility (mild EDSS) pre exercise rehabilitation program which was not changed post exercise rehabilitation program. The reason for this result could be that, EDSS required at least 6 months for remarkable change; while the present study rehabilitation program was initiated covering a period of 3 months. This result is in line with (Bjarnadottir, Konradsdottir, Reynisdottir & Olafsson, 2007; Dalgas & Stenage, 2012) who stated that, EDSS was stable in both of study groups, which, likewise, showed no significant effect of exercise training on mild EDSS.

Moreover, (Sandoval, 2013) pointed that, higher percentage of study group patients had mild to moderate EDSS that remain stable after program which produced improvement in aerobic capacity and in measures of HRQL, mood, and depression in patients with MS. Furthermore, (M€aurer et al., 2018) reported that, majority of patients with mild EDSS and the course of the exploratory endpoints EDSS indicated no notable changes after exercise program.

- **Functional Assessment of Multiple Sclerosis (FAMS);**

As regard mobility domain, the present study findings declared significant improvement in mobility level in study group post exercise rehabilitation program. This study finding might be related to the positive effect of exercise as it help on normalizing muscle tension, improving coordination and balance, increasing or maintaining the range of motion in the joints, preventing muscle atrophy and counteracting the consequences of immobilization.

This finding is in line with (Pilutti, Greenlee, Motl, Nickrent & Petruzzello, 2013; Platta, Ensari, Motl & Pilutti, 2016; Edwardsa & Piluttib, 2017) who reported significant improvement in walking endurance post exercise program. Furthermore, (Ensari, Motl & Pilutti, 2014) reported that, exercise training improves depressive symptoms in people with multiple sclerosis as well as lead to significant improvements in mobility level. Moreover, (Matthew et al., 2016) revealed

that, rehabilitation program favorably influences not only symptoms of MS but also functional mobility of patient with MS.

Concerning symptoms domain, the present study showed a highly statistically significant improvement in functional assessment symptom domain in study group post rehabilitation exercise program than pre exercise rehabilitation program. This result may be related to the fact that, cardiorespiratory training and neurorehabilitation in MS is associated with increased VO2 Max or VO2peak and working capacity, respiratory function and reduction of fatigue. Also Exercise can cause some changes such as neuroprotection and neuroplasticity, reduction of long-term inactivity and deregulation of hypothalamus-pituitary adrenal (HPA) axis and then reduction of tiredness and general health of patients with MS. Moreover some studies proposed detection of morphological changes with exercise in the CNS of MS patients by imaging techniques which may be the cause of decreasing signs and symptoms in MS. Furthermore, these studies suggested that, regular cardiorespiratory training work against brain degeneration in relapsing-remitting type of MS and probably are a protective strategy.

This finding is in line with (Sabapathy, Minahan, Turner & Broadley, 2012; Hayes, Gappmaier& LaStayo, 2011) who reported significant improvements in fatigue symptoms or severity and significant decreases in general, physical, and psychological symptoms after 8 to 10wk post exercise program. Also, (Coote, Hughes, Rainsford, Minogue & Donnelly, 2015) reported significant improvement in muscle endurance ,balance, fatigue and other MS symptoms**.** Furthermore, (Matthew et al., 2016) revealed that, rehabilitation program favorably improves symptoms of MS. Moreover (Ensari, Motl, Pilutti, 2014; Pilutti, Greenlee, Motl, Nickrent& Petruzzello 2013; Sandroff, Pilutti, Benedict & Motl, 2015; Platta et al., 2016) reported significant improvement in disability, physical fitness, physical function, and significant reduction in general and specific MS symptoms.

In relation to general contentment domain, the present study findings declared that, there was significant increase on general contentment or patient's satisfaction post exercise program than pre exercise rehabilitation program. It could be the cause of this result that rehabilitation program showed significant improvement in functional health status of the studied patients. This finding is in line with (Anthony & Gidugu, 2012) who reported stable level of satisfaction with life through 3-month follow-up post MS exercise program. In addition (Holmøy, Hanssen &Beiske, 2012) showed that most of those who have attended a four-week specialized rehabilitation program were satisfied with their stay and believe that it would have a positive effect on their general quality of life, their physical and mental health, their ability to cope with daily tasks and their participation in social activities. Furthermore, (Donzé, 2015) revealed that, multidisciplinary rehabilitation program provides positive effects and high satisfaction for patients with multiple sclerosis.

Moreover, (Alphonsus, Su & d'Arcy, 2019) reported that aerobic exercise and physiotherapy improves the satisfaction of MS patients with their physical, mental and social functioning. This result is in line with **(**Mota-Pereira et al., 2012) showed that a program of physical activity for 12 consecutive weeks reduced symptoms of depression in a sample of treatment-resistant patients with major depressive disorders. Also, (Swank et al., 2013 ; Sandoval et al., 2013) on their study showed improvements in aerobic capacity, mood and depression among patients with mild to moderate MS (EDSS < 7) post structural cardiorespiratory and aerobic training. Moreover, (Dalgas et al., 2015; Negaresh et al., 2019; Bahmani et al., 2019) on their study findings reported that exercise may be a potential treatment to prevent or reduce depressive symptoms in individuals with MS. These findings were in contrast to (Dettmers et al., 2009; Sabapathy et al., 2011) who reported either no sustained improvement or no change in depressive symptoms following exercise training program.

As regard thinking /memory and concentration, the present study findings declared that, there is no significant improvement regarding memory and concentration function post exercise program. This result may be related to the fact that short term interval exercises don't show significant improvement in memory functioning in RRMS type. Also, not all type of exercises give the same result as it was found that resistance training, balance and muscle toning exercises did not have the same results in improving memory function like aerobic exercise does.

These findings are in line with (Oken, Kishiyama, Zajde, Bourdette, Carlsen & Haas, 2004) who concluded that the exercise program had no impact on cognitive problems of patients with MS. Also (Baquet et al., 2019) stated that, short-term interval aerobic exercise training does not improve memory functioning in relapsing-remitting multiple sclerosis. These divergent results can be attributed to the differences in the types of exercises used or higher severity of the problems in memorization and concentration of some patients than others. On the other hand, this result is contradict to

(Motl and Sandroff, 2015) who pointed that appropriate exercise can lead to important improvements in different areas of cardiorespiratory fitness (Aerobic fitness) and in the concentration, working memory, and information processing rate of MS patients. Also, (Sandroff et al., 2015; Platta et al., 2016) revealed that, the exercise training help in improvement of cognition, particularly with respect to concentration and working memory.

Regarding family/ social well-being domain, the present study findings emphasized that, both control and study group patients reported very much family/ social wellbeing pre and post exercise rehabilitation program. These findings may be related to the fact that in Arab countries there is strong bond between family members than in western countries so this strong personnel relationships has been presented as a contributive factor to decrease stress and to improve coping mechanisms and increases self-efficacy to overcome barriers to being physically active in people with different chronic health condition. Also, it has been suggested that there was consistent and positive association between the provision of overall social support by parents, father, friends and family and more involvement of patients in overall physical activity.

This study finding is in contrast to (Pilutti et al., 2011; Wier, et al., 2011) who reported significant improvements in social function, after exercise program than pre exercise program. Also, (Cheung, et al., 2013) who indicated that, physical activity associated with improved HRQOL in persons with MS by increasing social support, decrease fatigue, depression and self-efficacy. Furthermore, (Geertz, Dechow, Patra, Heesen, Gold &Heinz Schulz, 2017; Kerling et al., 2015) in their study showed a significant improvement in social functioning (social interaction and social support from peers) after short term physical exercise intervention than pre exercise intervention.

Concerning overall functional status outcome, the present study result revealed significant improvement in functional status post exercise rehabilitation program than pre exercise rehabilitation program. This finding is consistent with (Tarakci, 2013) who demonstrated that supervised group exercise training is effective in improving balance, functional status, and quality of life in moderately affected people with multiple sclerosis, with no worsening of their clinical status.

Also, (Mayo, 2017) reported greater improvements in health status outcome, functional ambulation, strength, components of quality of life including frequency and intensity of fatigue symptoms, mood, and global physical function. Furthermore, (Grazioli, Tranchita, Borriello, Cerulli, Minganti & Parisi A, 2019) in their study confirm the beneficial effects of physical activity in achieving functional and psychological therapeutic outcomes in patients with MS. This result is in contrast with (Dalgas & Stenage, 2012) who reported that there is any change in functional status after an exercise intervention.

Regarding relations between socio-demographic data and overall functional assessment domains;

Concerning relation between patient's gender and overall functional assessment domains. The findings of the present study revealed that, there was no statistical significant relation between sex and overall functional assessment domains. This finding contradicts with (Kamran et al., 2016) who concluded that there was a significant relationship between gender and functional status.

Regarding relation between level of education and overall functional assessment domains, the present study revealed that, there was statistical relation between study group patient's levels of education, and overall functional assessment domains except thinking and fatigue and family/social wellbeing domain pre exercise rehabilitation program. This finding is in line with (Mielck et al., 2013) who reported that there was statistical relation between educational level and physical, psychological, spiritual as adult patients with chronic disease as MS.

In addition, (javed et al., 2016) revealed that, educated females patients reported better physical health as compared to uneducated females. The present study findings may be related to the fact that education builds knowledge, skills, and provide positive attitudes about health. Also when level of education is high it helps patients to understand well and follow exercise program regimen which lead to better health outcome. On the other hand patients with low educational level usually report lower levels of physical health, physical symptoms.

As regards relation between occupation data and overall functional assessment domains, the present study revealed that, there was statistical significant relation between study group patients and overall functional assessment domains except family/social wellbeing domain. This finding is consistent with (Miller et al., 2006; Pfaffenberger et al., 2007) who revealed that, there was significant relation between employed patients and their HRQOL as it was found that employed

patients have higher HRQOL than those with no employment. Also, (Flensner et al. 2013) denoted that, physical condition was assessed as significantly higher among those who worked.

Furthermore, (Jelinek et al., 2016) stated that, patients with employment had higher physical outcome than those unemployed. Moreover, (Salehi et al., 2016) reported that, the patients' who had no work showed lower QoL than employed ones. The findings of the present study may be related to employment plays a central role in providing financial income and nonfinancial gains, including social identity, social contacts and support, a means of structuring and occupying time, activity and involvement, and a sense of personal achievement.

V. CONCLUSION

In the light of the study findings, it can be concluded that there were not statistically significant differences among the study and control group preprogram.

- There was statistically significant differences and improvement at mobility, symptoms, emotional/ social wellbeing and general contentment domains in the study group than in the control group after application of exercise rehabilitation program. Therefore, the application of exercise rehabilitation program is more effective in improving health status outcomes on MS patients than those receives hospital routine care.

- Also there were statistical significant relation between level of education, occupation and overall functional assessment domains.

VI. RECOMMENDATIONS

Based on the findings of the present study the following recommendation are derived and suggested:

Recommendations for patients:

- All patients who had MS must perform different kind of exercises as early as possible and continuously to prevent occurrence of physical disabilities as a result of disease progress.
- A colored illustrated educational booklet should be available and distributed to all patients with MS.

Recommendations for nurses:

- In service training program should be carried out for nurses working in MS unit about the different types of exercises that perform especially to patients with MS.
- Newly recruited nurses should be attending exercise rehabilitation program for patients with MS.
- Periodic multidisciplinary scientific meeting should be carried out for physicians, nurses, physiotherapists about MS and its causes, advanced treatment, and rehabilitation program needed.

Recommendations for further researchers:

- Further research is needed to be conducted on larger sample size to attain more generalized results.
- Further studies are needed to increase follow up period.

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