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Environmental Barriers Affecting the Function of Individuals with Multiple Sclerosis Based on ICF Core Set

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Abstract

Background: The International Classification of Functioning, Disability, and Health (ICF) can identify body function, structure impairment, activity limitation, participation restriction, and contextual factors.
Objectives: Considering the importance of the role of environmental barriers in disability and function, this study aimed to investigate the environmental barriers affecting the function of individuals with multiple sclerosis (MS) based on the Comprehensive ICF Core Set for MS.
Methods: This cross-sectional study was conducted on individuals with MS who are registered in the ICF Medical Commission. The participants completed the consent form, the Persian version of the Craig Hospital Inventory of Environmental Factors, Functional Independence Measure (FIM), and a demographic questionnaire based on the ICF Core Set for MS. The data were analyzed using SPSS software (version 25).
Results: A total of 140 individuals with MS (34 males and 106 females) participated in this study. The most frequently reported environmental barriers were structural and physical, and the least frequently reported barriers were related to work and school. The barriers related to attitudes and support were significantly associated with the motor function ($P = 0.003$) and total FIM score ($P = 0.002$). The variables of attitudes and support and policies were the main predictors of motor function ($RS = 0.093$, $P < 0.001$) and the total FIM score ($RS = 0.109$, $P < 0.001$), respectively. None of the barriers was significant and predictive of cognitive function.
Conclusions: Since environmental barriers can affect the function of MS patients, authorities should implement the necessary strategies to eliminate these barriers and facilitate participation.

Keywords: Multiple Sclerosis, Function, Environment, Barrier, ICF

1. Background

Multiple sclerosis (MS) is a progressive disease that results in dysfunction by degrading the myelin of the central nervous system, and patients might show muscle weakness, spasticity, poor gait pattern, and difficulties in personal and instrumental activities of daily living (1). In addition to the daily life of patients and their caregivers, socioeconomic status and quality of life might be affected by MS (2, 3). According to statistics, Iran is one of the top 10 countries in the world regarding the occurrence of MS and has the first rank in the Middle East (4). The onset age of MS is within the range of 20 - 50 years, and its prevalence is higher in females than in males (5).

The investigation of the effect of the environment on the life of individuals with MS has shown that by changing environmental barriers to environmental facilitators, the quality of life of those with disabilities can be improved (6). According to studies, mobility factors for individuals with MS include the nature of the disease, its long-term effects, and personal, physical, and social factors. Therefore, rehabilitation specialists should be aware of these factors in evaluating and managing individuals with MS (7). In a study, Jalili investigated that individuals with MS face more physical and structural barriers and fewer barriers related to work and school (8). Furthermore, the results of Hamed's study showed that the most important functional barriers for individuals with MS included shopping in stores and shopping malls (74.2%), the presence of noise pollutants (87.1%), the attitude of family, friends, and acquaintances of the patient (52.0%), governmental policies

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and regulations (52.2%), and psychological services (83.8%) (9).

The World Health Organization (WHO), based on the International Classification of Functioning, Disability, and Health (ICF), describes an individual's function and disability in the environment (10). The ICF emphasizes three components, namely the body (i.e., structural and functional levels), activities/participation (i.e., individual and social levels), and contextual factors (i.e., personal and environmental levels) (11, 12). The ICF not only describes an individual's function affected by the physical environment but also offers a broad classification of facilitating or inhibiting environmental features.

In the field of rehabilitation, the ICF can identify individual impairment, activity limitation, and participation restriction and facilitate their management by reducing or increasing the relationship between biopsychosocial and environmental barriers (or underlying factors) (13, 14). Therefore, the ICF can be used to describe the general health experiences of individuals with MS and compare the experiences of these patients in different environments. Moreover, by recognizing the facilitating and inhibiting environmental barriers at the early stages of MS, it is possible to prevent and manage disabilities. Since MS and its disabilities can lead to functional limitations, it has a great effect on patients' daily living and their participation in the family and society. Additionally, recent models of human functioning, such as the WHO model, emphasize the environment as a determining factor in the occurrence of disability and agree that disability cannot be understood, disregarding the environment.

The environmental barriers include the physical and social environment and the attitudes with which individuals in society live. These barriers are interrelated with an individual's health at all levels (i.e., structural and physical function, daily activities, and participation in society). Participation is the main goal of rehabilitation, especially occupational therapy, in individuals with neurological patients, including MS. The environmental barriers might impose severe limitations on the level of participation of these patients. Sometimes the effect of these barriers on limiting the participation and activity of individuals with MS is greater than the effect of weaknesses and defects of body systems and organs caused by the disease (15).

2. Objectives

Despite the lack of studies in this field and the importance of the role of ICF environmental barriers in the disability and quality of life of individuals with MS, this study aimed to investigate the environmental barriers affecting the function of individuals with MS, based on the Comprehensive ICF Core Set for MS.

3. Methods

In this cross-sectional study, 140 individuals with MS participated. Sampling was carried out using convenience sampling in 2020 in Tehran and Khorramabad, Iran. After the identification of eligible participants through MS associations and welfare centers, they were contacted, and the objectives of the study were explained. If they would like, they could complete the consent form and enter the study. The participants should have a definitive diagnosis of MS by a neurologist (based on McDonald's diagnostic criteria), an age range of 20 - 60 years, and a score higher than 22 on the Mini-Mental State Examination cognitive test (16). The participants could be excluded from the study whenever they were unwilling to continue. At the beginning of the study, the individuals with MS were invited by the researcher to participate in the study by telephone calls. Adequate information was provided to the participants about the objectives of the research and the method of its implementation, and interested individuals completed the consent form. After completing the consent form, the participants also filled out the demographic questionnaire, the Persian version of the Craig Hospital Inventory of Environmental Factors (CHIEF), and the Functional Independence Measure (FIM). Additionally, the severity of disability based on the ICF was assessed based on the indicators determined in the medical records of patients in the welfare centers.

3.1. Craig Hospital Inventory of Environmental Factors

This tool has a long 25-item form and a 12-item Short-Form called CHIEF-SF (17). The long version consists of 25 items and takes 10 - 15 minutes to complete. The CHIEF focuses on the five domains of environmental barriers (i.e., policies; physical and structural; work and school; attitudes and support; services and assistance). Moreover, there are two items for each subscale. The scoring of each CHIEF item is the product of the frequency score (from never: 0 to daily: 4) and the magnitude of the impact score (a minor problem: 1, a big problem: 2) to produce an item score that ranges from 0 to 8. Therefore, higher scores indicate greater frequency and/or magnitude of environmental barriers (18). The test-retest reliability was estimated to be 0.93, and the repeatability coefficient was 0.93. Moreover, the internal consistency of the tool is estimated to be 0.80 based on Cronbach's alpha (19). Nobakht et al. confirmed that the CHIEF is reliable for Iranian individuals (19).

3.2. Functional Independence Measure

This tool is used to assess the patient's level of disability and takes 30 - 45 minutes to run. The tool has 18 items focusing on motor and cognitive functions and measures the fields of self-care, sphincter control, transfer, locomotion, communication, and social and cognitive skills. Each item was scored based on a 7-point ordinal scale ranging from 1 to 7. The higher score shows more independence in performing the task associated with that item. The total score for the FIM motor subscale is within the range of 13 - 91. The total score for the FIM cognition subscale is within the range of 5 - 35. The total score of the FIM (i.e., the sum of the motor and cognition subscale scores) is within the range of 18 - 126. The validity and reliability were confirmed by Brosseau among 81 individuals with MS. The interclass correlation coefficient (ICC) was 0.83 for the total score. Additionally, the internal consistency of the tool was calculated at 0.94 based on Cronbach's alpha (20). Naghdi et al. calculated the validity and reliability of this tool in 40 patients with stroke (21). The ICC was within the range of 0.88 - 0.98, and the internal consistency based on Cronbach's alpha was within the range of 0.70 - 0.96 (21). Therefore, the FIM was reliable for Iranian individuals.

The data were analyzed by SPSS statistical software (version 25). The distribution of data obtained from demographic information was investigated using descriptive statistics, including frequency, mean, and standard deviation (SD). The Spearman test was used to investigate the relationship between CHIEF and FIM subscales. Furthermore, the effect of environmental variables on patients' function was measured using multiple linear regression.

This study was approved by the Ethics Committee of Iran University of Medical Sciences, Tehran, Iran (IR.IUMS.REC.1399.176).

4. Results

A total of 140 individuals with MS with a mean age of about 40 years participated in the present study, 24% (n = 34) and 76% (n = 106) of whom were male and female, respectively. About 44% of these patients had an Expanded Disability Status Scale (EDSS) score above 4.5 and were unable to walk and move independently, and needed constant assistance. The rest of the participants had an EDSS score of 1 - 4. Table 1 shows other demographic information of the participants in this study.

Based on the FIM, the mean (SD) values of the motor subscale, including self-care, sphincter control, transfers, and locomotion, were 37.56 (10.59), 10.74 (4.21), 17.66 (5.4), and 10.17 (4.03), respectively. In addition, the mean (SD) values of the cognition subscale, including communication and social cognition, were 14.50 (5.91) and 19.80 (1.52), respectively. The total scores of motor and cognition subscales were 76.14 (20.30) and 34.30 (6.04), respectively.

Table 1. Demographic Characteristics [a]

Variables	Individuals with Multiple Sclerosis (n = 140)
Age (y)	39.75 ± 6.29
Gender	
Female	106 (75.7)
Male	34 (24.3)
Education	
High school or lower	87 (62.2)
University	53 (37.8)
Expanded Disability Status Scale score	
1-4	79 (56.4)
4.5-9	61 (43.6)
Occupation	
Employee	11 (7.9)
Unemployed	46 (32.9)
Retired	14 (10)
Housewife	69 (49.3)
Disability severity based on ICF	
Weak	75 (53.6)
Moderate	28 (20)
Severe	30 (21.4)
Very severe	7 (5)

Abbreviation: ICF, International Classification of Functioning, Disability, and Health.
[a] Values are expressed as No. (%) or mean ± standard deviation.

According to the results (Table 2), the most frequent environmental barriers reported by the individuals with MS were related to structural and physical barriers, attitude and support barriers, and policy barriers, with mean scores of 3.38, 2.25, and 2.05, respectively. Therefore, the least frequent barriers reported by individuals with MS were work-school challenges, with a mean score of 0.15.

The correlation test (Table 2) showed a strong and significant relationship among the scores obtained from the subscales related to attitudes and support in the CHIEF, motor function score (P = 0.003), and the total score of this scale (P = 0.002). Therefore, the correlation between the scores obtained from the subscale of services and assistance (P = 0.04) and the total score of the CHIEF (P = 0.02) was poor and significant (P = 0.02). Furthermore, the correlations between the subscale of services and assistance (P = 0.01), the total score of the CHIEF scale (P = 0.01),

Table 2. Mean ± Standard Deviation and Correlations of Subscales of the Craig Hospital Inventory of Environmental Factors and Functional Independence Measure

Variables	Mean ± Standard Deviation	CC r (P-value), Motor FIM	CC r (P-value), Cognitive FIM	CC r (P-value), FIM
Policies	2.05 ± 1.12	r = 0.093; P = 0.276	r = 0.128; P = 0.130	r = 0.123; P = 0.148
Physical and structural barriers	3.38 ± 1.13	r = -0.125; P = 0.140	r = -0.101; P = 0.237	r = -0.148; P = 0.086
Work and school	0.15 ± 01.77	r = 0.658; P = 0.038	r = 0.785; P = -0.063	r = 0.734; P = 0.029
Attitudes and support	2.25 ± 2.03	r = -0.250**; P = 0.003	r = -0.079; P = 0.356	r = -0.256**; P = 0.002
Services and assistance	1.29 ± 0.80	r = -0.171*; P = 0.044	r = -0.137; P = 0.107	r = -0.198*; P = 0.019
Total score	1.97 ± 0.81	r = -0.188; P = 0.026*	r = -0.084; P = 0.322	r = -0.200; P = 0.018*

Abbreviations: FIM, Functional Independence Measure; CC r, correlation coefficient.
[a] * Significance at the level of 0.05; **Significance at the level of 0.01.

and the total score of motor function were weak and significant. Therefore, the correlations between the subscale of services and assistance (P = 0.01), the total score of the CHIEF (P = 0.01), and the total function score were weak. No significant correlation was observed between barriers and cognitive function.

Consequently, according to the results obtained from multiple regression analysis related to the interaction between predictor variables with the motor subscale and the total score of stepwise FIM, both variables of attitudes and support and policy were the predictors of the motor subscale (RS = 0.093, P < 0.001) and the total FIM score (RS = 0.109, P < 0.001) in individuals with MS, respectively (Table 3).

The relationship between attitude and support and motor function variables was inverse due to the negative numerical value B. The relationship between the policy variable and the dependent variable (function) due to the positive numerical value B was direct. Another conclusion drawn from the value of B and the inverse relationship between attitude and support barriers and function was that attitude and support barriers were important and influential variables in the motor function of individuals with MS. This effect was such that motor function was increased by reducing barriers related to attitudes and support.

Regarding the importance and role of independent variables in predicting the regression equation, beta values should be used because beta values are standardized, and the relative importance of variables can be judged. The large value of beta indicates the relative importance and its role in predicting the dependent variable. Moreover, in this model, it can be said that the variable of attitudes and support had a much greater contribution to predicting the dependent variable (i.e., motor function and total function score) than the policy variable.

According to the results of stepwise regression analysis, none of the defined barriers was significant and predictive of cognitive function, which is consistent with the results obtained from Table 2 of the present study.

5. Discussion

The purpose of this study was to investigate the effect of environmental barriers on function in individuals with MS, which is the only study that addressed this issue in Iranian society. Although in the past, studies investigated environmental barriers, their effects on patients' function have not been studied. In Jalili et al.' s study, the most frequent environmental barriers that the individuals with MS reported were physical and structural barriers, and the least frequent of those barriers were related to work and school (8). However, some cases related to sampling time and differences in the urbanism structure of these studies could be effective as a result of research, especially since the present study was conducted during the coronavirus disease 2019 (COVID-19) pandemic with the least need for transfer and transportation; therefore, physical and structural barriers were expected to be reported less commonly. However, the patients reported physical and structural barriers as the most important barriers.

The individuals with MS with EDSS scores up to 9 were studied, people with MS with EDSS scores above 4.5 needed more assistance; therefore, they reported more barriers regarding attitudes and support and policies, respectively, after physical and structural barriers. Some studies, showed that the biggest barriers for patients with chronic diseases were related to structural and physical environmental barriers (22, 23). Whiteneck et al. also reported that physical and structural barriers and attitudes and support are important barriers affecting the lives of individuals with various disabilities, such as MS (17). Carlsson et al. also showed physical and structural barriers to be the most frequently reported barriers among patients with stroke (24). However, patients with neurological disorders, such as MS, usually experience varying degrees of motor problems, and participation in major activities requires transfer and locomotion. Even in severe and moderate patients,

Table 3. Analysis of Predictive Variables of Function Using Stepwise Regression [a]

Function and Variables	R Squared	Beta	B	*t*	P-Value
Motor function					
Attitudes and support	0.062	0.25	-2.49	-3.02	0.003
Attitudes and support	0.093	0.304	-3.03	-3.565	0.001
Policies	-	0.183	3.285	2.145	0.034
Sum function					
Attitudes and support	0.066	0.256	-2.72	-3.11	0.002
Attitudes and support	0.109	-0.321	3.41	3.79	< 0.001
Policies	-	0.218	4.11	2.58	0.011

[a] Variables included in the regression model were policies, physical and structural barriers, work and school, attitudes and support, services and assistance, and the total score of the Craig Hospital Inventory of Environmental Factors.

caregivers somehow face the challenges of transferring patients. Therefore, the presence of these barriers in the environment makes transfer and ambulation of these patients and their access to numerous environments and services, such as public places, recreation and sports centers, and medical centers, difficult, which has a negative impact on the physical and mental health of these patients. Consequently, maintaining the desired participation of these patients in society by adopting special measures and policies to remove physical and structural barriers should be a high priority.

This study's results showed that some barriers were significantly related to patients' function and motor abilities. Furthermore, motor function was significantly correlated with barriers related to attitudes and support and services and assistance. Dijkers, in his studies, also showed that the motor function of patients with spinal cord injury based on the FIM is strongly associated with physical and structural barriers and weakly with barriers related to services and assistance (25). Moreover, in the aforementioned study, the total score of the CHIEF showed a strong relationship with patients' motor function in the two studied countries, the United States and Turkey; nevertheless, in the present study, this relationship was weak (25). One of the most important reasons for the difference between the aforementioned study and the present study is the target population; accordingly, Dijkers studied patients with spinal cord injury, and the present study studied patients with MS regarding the range of disabilities with an EDSS score of 1 - 9, in which almost half of the participants did not have a significant motor disability (25).

According to this study's results, among the barriers related to policies, physical and structural, work and school, attitudes and support, and services and assistance in individuals with MS, the barriers related to attitudes and support and policies were the strong predictors of their motor function and their total function score. Dijkers, in a cross-sectional study, also demonstrated the FIM motor subscale as a strong predictor of participants' social participation in the study (25). It was reported that the score obtained from the FIM motor subscale was among the environmental barriers affecting individuals' social participation. Inconsistent with the results of the present study, the participants in the aforementioned study considered the high score of this subscale a barrier affecting their social participation in reporting structural and physical environmental barriers (25).

One of the limitations faced in the present study was the COVID-19 pandemic in the middle of the patient evaluation period, which caused some patients to refuse to participate in the study, and the sampling process was delayed. Therefore, it is suggested to conduct further studies according to the sampling of this study during the COVID-19 pandemic and the possibility of these conditions affecting the response of patients in the period after the outbreak of the disease in this field. Another limitation was that most participants were women and housewives. Therefore, the barriers to their participation were very different from the barriers for men.

Since this study was conducted in an urban context and a specific range of ethnicities, the generalization of the results to another society should be made with caution. Therefore, it is recommended to carry out these evaluations in other regions to investigate the diverse and generalizable range of the environmental problems and barriers of these patients and compare these data. In the present

study, only the list of environmental factors of the CHIEF was used to investigate environmental factors. Since this tool does not fully cover the environmental factors of the ICF, this issue can also be considered another limitation.

5.1. Conclusions

According to the obtained results, individuals with MS are more likely to face structural and physical barriers; however, the most frequent barriers affecting their function were related to attitudes and support and policies. Since these environmental barriers can reduce the level of function and undoubtedly reduce the quality of life of these patients, authorities should implement the necessary measures to remove these barriers; accordingly, individuals with MS can use facilities similar to others and participate in society.

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Footnotes

Authors' Contribution: All the authors equally contributed to preparing this article.

Conflict of Interests: The fourth author of this article is one of the associated editors of the journal. Other authors have no conflict of interest.

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