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Neurocognitive Decay in Puerto Rican Multiple Sclerosis Cases

Claudia L Ríos- López[4], Marcos Devarie-Homedo[1], Ángel Chinea-Martinez[3], Pedro Ruiz-Medina[1], Anwar Abdul-Hadi[1] and Karla Narváez-Pérez[1,2]*

[1]*Surgery Department University of Puerto Rico, Medical Sciences Campus*

[2]*Family Department, Universidad Central del Caribe, Puerto Rico*

[3]*Surgery Department, San Juan MS Center, San Juan, Puerto Rico*

[4]*Biology Department, Universidad de Puerto Rico, Recinto de Bayamón, Puerto Rico*

***Corresponding Author:** Karla Narváez-Pérez, Surgery Department University of Puerto Rico, Medical Sciences Campus.

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Abstract

Background: Multiple sclerosis (MS) is a neurological disorder with onset commonly observed in early and middle adulthood. The neuropathological process includes inflammation and demyelination of neurons in the central nervous system, causing dysfunction in the conduction of these cells. The lesions in the white matter of individuals with MS detected by magnetic resonance imaging (MRI) have been associated with dysfunction in memory, the total area of the white matter lesions in MS patients are the best predictor of neuropsychological dysfunction.

Objective: To analyze and compare the cognitive decay of a group of Puerto Rican MS patients that has not manifested yet, an impairment in verbal functions, execution and executive functions.

Methods: The EIWA-III was administered to a sample of 100 participants, all meeting the criteria of definitive diagnosis of MS. This study is exploratory and descriptive; all study participants should self-report as Puerto Ricans within the ages of 21 to 64 years old. A comparison will be made of execution of a matched group of the normative sample and the group of adults from 21 to 64 years with MS, belonging to the standardization sample in Puerto Rico. The data was analyzed using descriptive and inferential statistical calculations.

Results: These results showed the statistically significant differences for each subscale: Verbal IQ, Performance, Total and indexes EIWA-III, suggesting that the level of intelligence of the MS sample group, 21 to 64 years old, was below average in comparison to the normative group. Survey results reflect significant differences in the scores of the subtests that make up the intelligence scale EIWA-III. In all measures, the group of participants with MS had a lower ratio than the reference group. The comparison of scores on the subtests that measure executive functions was analyzed by the working memory index (WMI). Based on the data obtained, the performance in executive functions EIWA-III was significantly lower in participants with MS compared to the reference groups. The domains that are most often affected are attention, memory, and information processing speed. The results are consistent with the literature reports on cognitive neuropsychology and performance of subjects with MS diseases.

Conclusion: This study will help understand the susceptible regions of cognitive dysfunction of Puerto Rican MS patients. This information will help identify the most affected areas of cognition in order to offer the patient better treatment and early cognitive rehabilitation.

Keywords: *Neuropsychology; Neurocognitive; Multiple Sclerosis; Dysfunction; Performance*

Abbreviations

MS: Multiple Sclerosis; EIWA-III: "Escala de Inteligencia Wechsler para Adultos; tercera edición"; CNS: Central Nervous System; CIS: Clinically Isolated Syndrome; IQ: Intelligence Quotient; ANOVA: Analysis of Variance; POI: Perceptual Organization Index; WMI: Working Memory Index; SPI: Speed Procedure Index; MRI: Magnetic Resonance Imaging; CI: Cognitive impairment

Introduction

Currently Multiple Sclerosis (MS) is considered one of the most prevalent chronic neurological disorders in young and middle adulthood, with a peak incidence in the third decade and the highest prevalence within 40 to 59 years of age. Women present a higher tendency to develop MS with an average ratio of 2.6 to 1. MS is a degenerative and autoimmune disease of the central nervous system (CNS) in which the immune system, normally charged with fighting off invading organisms, attacks the body's myelin sheaths, the protective insulation that envelops neurons and facilitates high-speed neuronal communication. Without myelin to assist and protect neurons, the brain and spinal cord signals that permit us to interact with our environment malfunction [1]. The neuropathological process includes inflammation and demyelination of neurons in the central nervous system, causing dysfunction in conduction. The clinical presentation of MS is caused primarily by demyelination (destruction of the myelin sheath), with associated inflammation and visible white matter lesions in magnetic resonance studies are a prominent feature. Diagnosis in MS is difficult due to the relapsing and remitting pattern, the subtle nature of symptoms and the apparent similarity with other diseases, especially, auto-immune ones. MS subtypes have been identified as relapsing remitting MS, progressive relapsing, primary progressive and secondary progressive. The most aggressive and likely type to produce morbidity is primary progressive. Another important clinical category within the MS spectrum is the clinically isolated syndrome (CIS) an isolated CNS syndrome (optic neuritis, incomplete transverse myelitis, brainstem or cerebellar lesion) which is often the first MS attack [2]. Clinical symptoms in MS include motor weakness, loss of coordination, paraparesis (motor weakness on lower extremities), vision changes, dyplopia, nystagmus, dysarthria, intention tremor, ataxia, somato-sensory changes (paresthesias) and bladder dysfunction. Other important and common, but sometimes underreported symptoms include cognitive and affective changes [3]. The MS patients tend to have few cognitive deficits. Also the patients usually present memory deficits confined to the verbal area. The severity of cognitive dysfunction varies, as does the patterns of deficit. The domains commonly affected are attention, memory, and information processing speed. Visual spatial perception and executive functions may also be impaired, but language and intellectual functions are typically preserved. Lesions in the white matter of individuals with MS, detected by magnetic resonance imaging (MRI), have been associated with memory dysfunction, especially in short term and working memory. The total area of white matter lesions in MS patients is the best predictor of neuropsychological dysfunction. As the disease progresses, usually with a series of acute immune attacks and a late-stage steady march of function loss, patients with MS commonly experience fatigue, spasticity, difficulty walking, and cognitive impairment [4].

Cognitive impairment occurs in 40-65% of multiple sclerosis (MS) patients, typically involving complex attention, information processing speed, (episodic) memory and executive functions. These changes can occur at any time (even as a first symptom of MS) but are more common later in the disease. Cognitive function correlates with the number of lesions and lesion areas on MRI, as well as brain atrophy. Cognitive changes generally progress slowly but are unlikely to improve dramatically once they have begun affecting personal life and vocational status [5]. Cognitive symptoms have been found to be a good predictor of distress and disability, as well as in occupational, social, and overall impairment. Cognitive deficiencies tend to be more prevalent in the later stages, although in some cases they may be detectable at an early phase of the disease [6]. Earlier symptoms can involve information processing speed and verbal fluency [1]. The later symptoms may involve deficits in memory, conceptual/abstract reasoning, attention, moderate to severe decrease in the speed of information processing and visuo-spatial functions [7]. A recent study with 416 relapsing remitting patients found that processing speed seems to be the most significant cognitive symptom in Relapsing Remitting MS [8].

Although MS subtypes have been identified based on severity and progression, the clinical neuropsychological presentation within subtypes is quite unpredictable and overlaps with motor/neuromuscular and affective domains. However, despite the difficulties to es-

tablish a neuropsychological profile in MS some variables including the area of the lesions, progression of disease, number of years from initial diagnosis, mood/depression and fatigue mediate the neuropsychological symptoms in each patient [9]. Recently, some researchers have established that neuropsychological symptoms are one of the most disabling yet poorly understood and measured features of the disease and have been documented in 40% to 60% of the patients [6]. Also these symptoms can predict performance on simple and complex activities of daily living needed for occupational tasks and independent living.

As a consequence of sensory motor difficulties observed in MS general intelligence measures like the Wechsler's Intelligence Scale reveal that MS patients tend to have difficulties in performance subtests and Perceptual reasoning indexes [10]. However, when comparing performance within the MS samples, Performance IQ seems to be more impaired than Verbal IQ even in patients with no physical disability as measured with EDSS [10]. Nonetheless, intelligence as a general measure depends on lower hierarchy functions like speed of processing, sensory and motor functions which are all consistently negatively affected in patients with MS. The memory performance in MS patients might be in part influenced by the attention and psychomotor speed difficulties that these patients experience, therefore measures used to evaluate different aspects of a patient's memory should control for the above for example viso-perceptual deficits and processing speed. Visuo-spatial and visuo-perceptual abilities appear to be impaired in approximately 20% of patients with MS [10]. Short term memory and working memory studies in MS have found that arithmetic seems to be more impaired in patients with MS suggesting that working memory deficits tend to be more pervasive as they involve processing simultaneous information. Working memory deficits seem to be directly related to the course and severity of the disease and Primary Progressive patients seemed to be more impaired in Working Memory [11]. Other studies establish that the fundamental difficulties in WM are directly related to processing speed [5].

Processing speed deficits seem to be the most evident and fundamental deficit in MS [5]. Due to the white matter abnormalities of MS and lack of myelin in nerve conduction, processing speed difficulties are identified in many patients with MS [5]. The executive functions performance evaluated in MS patients in terms of planning, flexibility, and inhibition. MS patients seem to present moderate to severe deficits that are in part mediated by processing speed difficulties. Executive deficits in MS have been associated with depressed mood. Also, deficits in executive functions may be evident in clinical observations and every day quality of life questionnaires [12]. Studies of assessment measures of language functioning in MS have found that verbal fluency and word finding tends to be affected even at early stages of the disease [10].

Also Cognitive difficulties can be confounded by the emotional symptoms and psychiatric manifestations that accompany this disorder. The emotional disturbances most commonly associated with MS are depression and anxiety [13]. Studies support that depression is the most prominent emotional disturbance identified in MS [12]. Other studies of MS discovered that physical disability and fatigue were indirectly predictive of depressed mood via recreational functioning. However fatigue was directly related to depressed mood in MS. One of these studies found that focused on exploring what affective and cognitive factors contribute to the presence of depression symptoms. The authors concluded that interventions for depression might improve the patient's self perceptions and quality of life [13].

The evaluation and measurement are tools of intelligence used by professionals of psychology to identify potential and needs of individuals. The EIWA-III is a validated instrument used for this purpose [14]. Current studies show differences in executive functions and processing speed among people with MS when compared with normative samples of the tests used. The concept of psychological measurement is based on the interest of deepening the knowledge about human beings. This area of psychology is rooted in the need to understand and analyze the intellectual and psychological differences between individuals and different reactions of the same person. Psychology as a science requires assessment, exploration, control, and prediction of human behavior. The development and management of assessment instruments are relevant to psychological measurement. Psychologist evaluation instruments used to obtain a more objective and accurate measure of those cognitive skills or psychological traits of the individual being evaluated. For the last twentieth century, the creation and administration of psychological tests to measure behavior patterns of people have experienced a significant increase in different parts of the world. The development and use of more objective tests to measure patterns of human behavior is a phenomenon observed with equal increase in Puerto Rico [14].

In Puerto Rico, there is no research on the applicability, validity, and reliability of psychological measurement instruments [15]. The objective of this study was to evaluate and compare the Intelligence Quotient (IQ) obtained through the test to measure intelligence Wechsler Intelligence Scale for Adults (EIWA-III, 2008) of a group of Puerto Ricans MS patient between the ages of 21 to 64 years with the standard set. Although the test has been translated, adapted and standardized for Puerto Rico, it does not provide data about its usefulness for differential diagnosis in people with MS between the ages of 21 to 64 years to facilitate the work of clinical and counseling Psychologists. Despite our cultural diversity, in the island, up until 2008, the EIWA was the main tool used to measure adult intelligence for Puerto Rican or Hispanic residents [15]. However, due to the specific problems that are generated by the use of a foreign instrument, it does not respond to the socio-cultural context of the population, in which it is used.

The present study analyzes and compares the intellectual functioning group with MS between the ages of 21 to 64 years and the normative group on Adult Intelligence Scale- Wechsler-III. This study took into account the absence of clinical instruments for the assessment of intelligence in people with this neurological disorder in the Puerto Rican population. Our results meet the study objectives stated in terms of knowing the IQ, verbal, perceptual, working memory and processing speed. The results of this study are consonant with the purpose that involves evaluative metering in terms of intelligence tests used to determine IQ and cognitive functioning for MS patients. These findings will be useful because they provide and add data to the meter depending on the age group of clinical populations (MS) not investigated at the time to adjust and normalize EIWA-III in the adult population of Puerto Rico [16].

Through the years there is a clear need for measurement instruments that are valid and reliable for a full and proper assessment of the population of Puerto Rico. According to the research team, the lack of analysis on the applicability, validity, and reliability of psychological measurement instruments used in Puerto Rico is evident. Through this study, we proposed an analysis of the differences in IQ of people with MS condition, to be compared with the matched sample policy group in EIWA-III. The information obtained, provides objective evidence of the Scale Wechsler Adult Intelligence-III about the sample population analyzed, which contributed with useful, relevant, timely information, and contributed to the advancement of knowledge, literature and scientific work in the island. Other studies found that the location, the age of the onset and dominance are the best predictors of the scores for the scales of Total, Verbal, and Performance. Based on the literature, the results of this study will generate new approaches, theories, and the development of tools for mediation through the application of the scientific method. The results of this research in the field of MS were the basis for expanding knowledge, measuring performance of people with MS in Puerto Rico, and the benefit of future researchers with updated information about the variables related to the condition of MS. These results are useful because they provide the basis for further studies in the future; develop possible avenues of intervention and support for Puerto Rican MS patients.

Materials and Methods

Materials

EIWA-III test.

Methods

For the purpose of this study, a quantitative nature exploratory/descriptive research design was selected. From the exploratory design perspective it provided the flexibility to analyze and discover new information about the phenomenon of the variable under investigation. It allowed establishing quantitatively possible relationships or contrasts between the study variables. From a descriptive perspective, it allowed for an accurate description of the phenomenon of the analyzed variable, which is to prevent the results from being flawed. The purpose of using this design responded to the interest of having to explore, introduce and describe the possible differences in performance IQ of subjects with MS compared to the U.S.A. group.

The target population to participate in this study was Puerto Ricans between the ages of 21 to 64 years residing in Puerto Rico who had been diagnosed with the condition of MS. Among this population, the sample of participants was selected by combining techniques and availability intentional given the accessibility of participants. Therefore, the intentional selection of participants responded to the following specific inclusion criteria: 1) have documented diagnosis of MS, 2) be under drug treatment for MS condition and have controlled the disease, 3) being between the ages of 21 to 64 years-old, 4) have resided in Puerto Rico most of their life or for a minimum of 10 years. This research was approved by the Institutional Review Board of Universidad Central del Caribe; participation was voluntary and placed a call for the subject's poster in Caribbean Neurological Center. The participation of each person, who met the inclusion criteria by availability, until the expected number was met, was limited, freely and voluntary, avoiding pressure or force to participate in the study. On the other hand, the following exclusion criteria were set: 1) people not diagnosed with a condition of MS, 2) people under 20 years, 3) people who were not residents of Puerto Rico or had less than 10 years residing in the island. The research instrument used was the Wechsler Intelligence Scale for Adults, tailored and standardized for Puerto Rico (EIWA-III). Data collected through the research process was tabulated including analysis of average, standard deviation (s), the simple analysis of variance and analysis of Student *t* test to establish differences and comparisons. The simple analysis of variance/ANOVA (F) was used to compare the values of a set of numerical data to determine whether they were significantly different from the values of other data sets. The analysis of variance/ANOVA was used to associate probability to the conclusion that the average of a set of scores is different from the mean scores of the other group. The Student *t* test was used to compare the performance of participants in terms of the total scores of the scales Verbal, and Total Execution. In addition, the mean and standard deviation for the total scale, performance scale and verbal scale was calculated.

Results

The total participants consisted of 100 subjects, 29 males and 71 females. In 91% of participants, the condition was controlled with medication and 9% was not controlled with medication.

Analysis of Total Intelligence Quotient includes the contrast of the results on the scales of Verbal IQ and Performance by Puerto Ricans MS group of 21 to 64 years-old**.** The summary of comparative performance EIWA-III table presents the comparison of the four studies together. Where there are ratios and indexes of the performance of the EIWA-III. It shows the size of each sample, averages and standard deviations for study. There are two studies with people with multiple sclerosis, one with depression and another with cognitive impairment. The statistical differences among the four above groups will transpire in the following tables. Refer to table 1.

	M	SD	t	df	p	Cohen´s d	BCa 95% Confidence Interval	
							Upper	Lower
Verbal Intelligence Quotient (VIQ)	95.83	15.32	-2.720	99	.008	-0.27	-7.026	-1.011
Intellectual Execution Quotient (IEQ)	88.67	14.62	-7.748	99	.000	-0.77	-14.112	-8.174
Total Intelligence Quotient (TIQ)	92.15	14.56	-5.389	99	.000	-0.54	-10.831	-4.720
Verbal Comprehension Index (VCI)	96.17	13.82	-2.770	99	.007	-0.27	-6.649	-.912
Perceptual Organization Index (POI)	98.00	15.75	-1.270	99	.207	-0.13	-4.942	1.109
Working Memory Index (WMI)	99.91	16.51	-.054	99	.957	-0.005	-3.510	3.241
Processing Speed Index (PSI)	84.22	20.58	-7.667	99	.000	-0.77	-20.010	-11.793
Note: Test Value 100								

Table 1: *Comparison of MS sample EIWA-III mean scores with normative sample.*

Analysis of variance between the Quotients and Indexes amongst the four studies reveals that each quotient and index has averaged (arithmetic mean) statistically different among the four studied samples from two countries (United States and Puerto Rico) and three conditions/disorders (multiple sclerosis, cognitive disability and depression). Similarly, when comparing displays calculating the F Analysis of Variance (ANOVA) of each quotient and index of the four studies analyzed, the level of significance of each F is equal to or less than .0001. This establishes that the averages of the four exhibit different results within each other. This explains why the arithmetic means in combination with their respective standard deviations are statistically heterogeneous among themselves. The four compute an F (ANOVA) and the Index Ratio EIWA-III that also show differences between the scores of quotients and indices for each study because the arithmetic means and their relationship with standard deviation do not agree among themselves. To demonstrate the differences between each quotient and index is table 3 that checks the arithmetic mean of each ratio and index among countries applying a student *t* for independent groups (Tukey Post Hoc Procedure and Evidence). Presented in the table are country differences for each quotient and index; therefore, we can understand what the marked differences in the table analysis of variance between the Quotients and Indexes amongst the four studies reviewed are constituted. Refer to table 2.

	(CIV)		(CIE)		(CIT)		(ICV)		(ICP)		(IMP)		(IVP)	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
High School or less	88.13	14.999	83.33	15.77	84.73	15.08	88.40	12.36	93.60	16.18	91.67	14.90	75.27	22.99
1 - 3 years College Education	90.00	14.024	83.16	10.48	86.5	11.70	90.84	13.10	91.60	14.34	95.56	15.98	79.44	18.66
Bachelors	99.60	13.660	90.93	14.92	95.43	13.64	99.60	12.85	101.10	16.51	102.95	16.21	87.86	19.81
Graduate Studies	101.56	16.836	95.50	14.698	98.50	15.53	102.06	13.63	103.33	12.23	105.72	16.26	89.83	20.56

Table 2: *Mean and standard deviation EIWA-III score by educational level.*

In table 3, we can observe the results of the analysis of student *t* for independent groups by condition (MS: Multiple Sclerosis.CD: Cognitive Disability. D: Depression) and by the ratio study/country. The comparison between the sample of multiple sclerosis in the United States (2008) and the sample of Puerto Rico (2013) of multiple sclerosis (USA 2008 (MS)/PR 2013 (MS)) regarding Verbal intellectual quotient (VIQ) received a t = 2.225 at the .03 level of significance. This suggests that the multiple sclerosis sample (n = 23) of the United States obtained a verbal intellectual quotient (VIQ) statistically superior to the multiple sclerosis sample (n = 100) of Puerto Rico. When we compare the cognitive disability sample (n = 50) of United States (2008) with the multiple sclerosis sample (n = 100) of Puerto Rico (2013) (USA 2008 (CD) /PR 2013 (MS)) concerning the verbal intellectual quotient (VIQ) the result was a t = - 18.967 at the.0001 level of significance. This means that the multiple sclerosis sample of Puerto Rico obtained a verbal intellectual quotient (VIQ) scientifically superior to that of the United States cognitive disability sample.

Table 3 shows the discrepancy between the depression sample of the United States and the multiple sclerosis sample of Puerto Rico (USA 2008 (D) /PR 2013 (MS)) in relation to the verbal intellectual quotient (VIQ). The statistical result was a t = 0.141 not significant at the .05 level. The United States depression group (n = 30) is very similar to multiple sclerosis of Puerto Rico (n = 100) in connection to the verbal intellectual quotient (VIQ). The result regarding the execution intellectual quotient of the US multiple sclerosis sample (n = 23) versus the multiple sclerosis sample (n = 100) of Puerto Rico (USA 2008 (MS) /PR 2013 (MS)) is a t = 4.09 with a .0002 significance level. This reveals that the sample of the United States obtained an execution intellectual quotient (EIQ) statistically superior Puerto Rico's sample.

	F	df	df	p	η^2
Verbal Intelligence Quotient (VIQ)	4.60	3	96	.005	0.13
Intellectual Execution Quotient (IEQ)	3.786	3	96	.013	0.11
Total Intelligence Quotient (TIQ)	4.91	3	96	.003	0.13
Verbal Comprehension Index (VCI)	5.39	3	96	.002	0.14
Perceptual Organization Index (POI)	3.19	3	96	.027	0.09
Working Memory Index (WMI)	3.248	3	96	.025	0.09
Processing Speed Index (PSI)	2.374	3	96	.075	

Table 3: *Statistical differences results by educational level.*

Analyzing the results of the cognitive disability sample (n = 50) of United States (2008) with the multiple sclerosis sample (n = 100) of Puerto Rico (2013) (USA 2008 (CD) /PR 2013 (MS)) the execution intellectual quotient (EIQ) weighed against each other was t = - 15.84 at the .0001 significance level. This denotes that the multiple sclerosis sample (n = 100) of Puerto Rico (2013) got an execution intellectual quotient (EIQ) scientifically superior to the cognitive disability sample (n = 50) of the United States (2008). The above table shows the discrepancy between the depression sample of United States (n = 30) and the multiple sclerosis sample (n = 100) of Puerto Rico (USA 2008 (D)/PR 2013 (MS)) in relation to the execution intellectual quotient (EIQ) with a t = 1.854 and not significant at the.05 level. In relation to the execution intellectual quotient (EIQ), the United States depression sample is statistically similar to the multiple sclerosis sample of Puerto Rico. Following the quotient analysis, the table presents the index breakdown with the results of the student t for independent groups by study/country values. Regarding the verbal comprehension index (VCI), the comparison between the sample of multiple sclerosis of the United States (2008) and the sample of Puerto Rico (2013) of multiple sclerosis (USA 2008 (MS) /PR 2013 (MS)) received a t = 2.41 at the .02 level of significance. This suggests that the multiple sclerosis sample (n = 23) of the United States obtained a verbal comprehension index (VCI) statistically superior to the multiple sclerosis sample (n = 100) of Puerto Rico.

When testing the average of the cognitive disability sample of the United States (2008) against the multiple sclerosis sample of Puerto Rico (2013) (USA 2008 (CD)/PR 2013 (MS)) on verbal comprehension index (VCI) the result was a t = - 17.1816 at the .0001 level of significance. This signifies that the multiple sclerosis sample of Puerto Rico obtained a much higher verbal comprehension index (VCI) than the cognitive disability one of the United States. The table shows the comparison between the samples of the United States depression study and Puerto Rico's multiple sclerosis research (USA 2008 (D)/PR 2013 (MS)). This assessment tested on the verbal comprehension index (VCI) with a student t of 0.141 and not significant at the .05 level. The United States depression group is very similar to the multiple sclerosis one of Puerto Rico concerning the verbal comprehension index (VCI). There are no statistically significant differences.

The table 4 also presents the comparative results of the perceptual organization index (POI). It indicates the contrast between the multiple sclerosis sample of the United States (2008) with the multiple sclerosis sample of Puerto Rico (2013), in relation to the perceptual organization index (POI). This contrast produces a t = 1.39521, not significant at the .05 level. Therefore, it reveals that the United States sample obtained a rate of perceptual organization index (POI) statistically similar to Puerto Rico. When comparing the United States (2008) sample of subjects with cognitive disability with the multiple sclerosis sample of Puerto Rico (2013) (USA 2008 (CD) /PR 2013 (MS)) in relation to the perceptual organization index (POI) the statistical analysis indicates a t = - 15.75 at the .0001 significance level. This means that the multiple sclerosis sample of Puerto Rico got a superior perceptual organization index (POI) against those with cognitive disability in the United States.

	CIV	CIE	CIT	ICV	ICP	IMP	IVP
CIV							
CIE	.698**						
CIT	.936**	.895**					
ICV	.924**	.673**	.880**				
ICP	.647**	.880**	.808**	.628**			
IMP	.827**	.632**	.807**	.643**	.641**		
IVP	.553**	.760**	.698**	.515**	.679**	.552**	
Years of diagnosis	.048	.018	.033	-.005	-.024	-.013	.038
Note: **p < 0.01							

Table 4: *Correlations between EIWA-III scores and years with MS diagnosis.*

The examination involving the depression sample of the United States and the multiple sclerosis one of Puerto Rico (USA 2008 (D)/ PR 2013 (MS)) about perceptual organization index (POI), resulted in a t = -0.816758 and not significant at the.05 level. United States depression sample is statistically comparable to the multiple sclerosis sample of Puerto Rico in relation to the perceptual organization index (POI).With respect to the working memory index (WMI) and the comparison of multiple sclerosis studies, the multiple sclerosis sample of the United States (2008) was weighed against the multiple sclerosis sample of Puerto Rico (2013) receiving a t = 0.125951 not significant at the.05 level. This indicates that the United States sample obtained is similar to Puerto Rico's working memory index (WMI).

The sample of subjects with cognitive disabilities of the United States (2008) compared to the multiple sclerosis sample of Puerto Rico (2013) (USA 2008 (CD)/PR 2013 (MS)) in relation to the working memory index (WMI) produced great differences. The result was a t = - 19.664 significant at the .0001 level. This means that the multiple sclerosis sample of Puerto Rico obtained a higher average than the cognitive disabilities sample from the United States in the working memory index (WMI). Table 3 shows the similarities between the United States depression study and the multiple sclerosis one of Puerto Rico (USA 2008 (D) /PR 2013 (MS)) about the (WMI) working memory index. The result was a t = -0.212, not significant at the.05 level. The United States depression group is alike with the multiple sclerosis group of Puerto Rico, in relation to the working memory index (WMI).

The speed procedure index (SPI) results reflect differences between the multiple sclerosis sample of the United States (2008) and the multiple sclerosis sample of Puerto Rico (2013). The difference is demonstrated through a t = 12.8938 significant at the .0005 level. This indicates that United States samples obtained a speed procedure index (SPI) average much higher than Puerto Rico's. In regard to the speed procedure index (SPI) the above table presents the results of the cognitive disabilities sample of the United States (2008) compared to the multiple sclerosis sample of Puerto Rico (2013), (USA 2008 (DC) /PR 2013 (EM)). The differences are stated with a t = -13.57 significant at the level. This means that the multiple sclerosis sample of Puerto Rico has a superior average of speed procedure index (SPI) than the cognitive disabilities sample of the United States.

The comparison between the depression sample of the United States (2008) and multiple sclerosis sample of Puerto Rico (2013), testing for possible differences among the speed procedure index (SPI) averages produced a t = 3.7775 meaningful at the .0005 level. The United States depression group average is higher than that of multiple sclerosis of Puerto Rico in relation to the rate of speed procedure index (SPI).

Discussion

The research problem was to evaluate and compare the IQ, obtained through the EIWA-III of a group of Puerto Ricans MS patients. Analysis of variance/ANOVA showed that there was a significant difference between the group of young Puerto Ricans from 21 to 64 years

with MS when compared to their score, in IQ, with the U.S.A. group with the condition, in scales of the Verbal Scale, Performance, and Total IQ indexes on EIWA-III test. The apparent differences between groups arise that the pattern of performance of Puerto Ricans with MS differs from the pattern of performance of the four comparison groups: the group of adults 21 to 64 years and EIWA-III U.S.A. group in each subtest included in the verbal scale, Implementation of Total IQ and Index. The analysis shows that apparently Puerto Ricans 21 to 64 years of age with MS do not respond to the same rules as the four comparison groups. The group of people 21 to 64 years with MS scored lower average scores in Performance, as well as in the subscales Perceptual Organization Index and Processing Speed Index Scale Indexes. The difference in the pattern of performance demonstrated that the Puerto Ricans with MS, when compared to the other four groups, suggests that both groups are not representative of the typical characteristics of this group of people, given that they detract from predictive tests and its components according to the scientific perspective and literature [18]. Studies are ongoing to identify ways to stabilize or improve cognitive dysfunction. Cognitive behavioral therapy, exercise, and education programs are promising psychosocial interventions to improve coping and lessen cognitive symptoms. In comparison to other studies, such as cognitive dysfunction in early MS, higher physical activity levels are shown to be associated with increased grey and white matter volumes in cognitive brain regions on volumetric MRI [21]. However, if the cognitive impairment has taken over the MS patient, it is unlikely that physical activity will be as helpful as it would be in early MS. In addition, structured physical activity rehabilitation programs may contribute to cognitive stability or improvement in the MS population [21]. Since the disease-modifying drugs have all been shown to reduce the accumulation of new demyelinating lesions, it is likely they help to stabilize cognitive changes. However, cognitive rehabilitation in MS patients is still in its infancy, and more studies are needed to determine their effectiveness in this area. By studying cognitive rehabilitation, people with MS might increase their awareness of their own cognitive impairment and learn to manage CI on a daily basis [21]. Cognitive rehabilitation could also reduce cognitive deficits through cognitive retraining.

Conclusion

Multiple Sclerosis (MS) is a degenerative and autoimmune condition considered one of the most prevalent chronic neurological disorders in young and middle adulthood with a higher prevalence rate for Women. MS Clinical presentation is caused by demyelination, inflammation and visible white matter lesions. Pathologic damage is caused by T lymphocytes that become activated, gain entrance to the blood brain barrier and affect the myelin, disrupting central nerve transmission. Neuroimaging techniques like magnetic resonance spectroscopy indicate that axonal damage and neuronal loss results of this disease process eventually leads to brain atrophy and correlate best with clinical disability [19]. Another important clinical category within the MS spectrum is the clinically isolated syndrome (CIS). Sometimes underreported symptoms include cognitive and affective changes [3]. Cognitive symptoms in MS involve deficits in visuo-spatial skills, memory, speed of processing, visuo-spatial abilities, executive functions and verbal fluency. Cognitive difficulties can be confounded by the emotional symptoms and psychiatric manifestations that accompany this disorder. The emotional disturbances most commonly associated with MS are depression and anxiety [13,20], with depression identified as the most prominent. Studies are ongoing to identify ways to stabilize or improve cognitive dysfunction. Cognitive behavioral therapy, exercise, and education programs are promising psychosocial interventions to improve coping and lessen cognitive symptoms. Since the disease-modifying drugs have all been shown to reduce the accumulation of new demyelinating lesions, it is likely they help to stabilize cognitive changes. However, cognitive rehabilitation in MS patients is still in its infancy, and more studies are needed to determine their effectiveness in this area.

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Conflict of Interest

None to be disclosed.

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