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Beyond Physical Disability: The Social Cognition Challenges in Quality of Life Among Multiple Sclerosis Patients

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Abstract: Introduction: Social cognition impairment is common in multiple sclerosis (MS) and could implicate the well-being of patients by promoting difficulties in social interactions. This study investigated the relationship between social cognition and quality of life (QoL) in patients with MS (PwMS). Methods: One-hundred PwMS, enrolled as per distinct criteria, underwent neuropsychological assessment using validated questionnaires and scales. To assess QoL, Multiple Sclerosis Quality of Life -54 (MSQOL-54) questionnaires, both physical and mental, were utilized. Components of social cognition were evaluated using the Reading the Mind in the Eyes test (RMET) and the Faux Pas task. Type of MS and years since diagnosis were also recorded.Results: The RMET score ($\beta = 0.336$, $p = 0.001$) and years since diagnosis ($\beta = -0.225$, $p = 0.017$) emerged as significant predictors of physical QoL, whereas the Faux Pas score did not significantly predict MSQOL-54_PHYSICAL scores ($p = 0.451$). Both Faux Pas ($\beta = 0.247$, $p = 0.015$) and RMET scores ($\beta = 0.221$, $p = 0.028$) showed a positive association with MSQOL-54_MENTAL scores. Years since diagnosis did not significantly predict the mental component of QoL ($p = 0.635$). Conclusion: Social cognition deficits are crucial for social functioning of the patients with MS, inevitably affecting both physical and mental aspects of QoL.

Keywords: multiple sclerosis; quality of life; social cognition; cognitive impairment; theory of mind; emotion recognition; Beyond physical disability: The social cognition challenges in quality of life among multiple sclerosis patients

1.Introduction

Multiple sclerosis (MS) is a chronic, immune-mediated demyelinating disease of the central nervous system, causing impairments in multiple physical domains (i.e. sensorimotor, visual, cerebellar, brainstem, bowel/bladder) as well as deficits in cognition [1]. Neuro-cognitive impairment in MS is prevalent in up to 70% of the patients, involving decline in working memory, information processing speed, learning and memory, executive functions and social cognition [2].

Social cognition refers to a construct of various processes which define social interactions, by perceiving social stimuli, interpreting and generating responses to behaviors of others [3]. Basic

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elements of social cognition are the Theory of Mind (ToM), emotional empathy and social perception, including emotional expression recognition. These functions coordinate vital characteristics of social participation and could influence quality of life (QoL) in various neurological diseases [4]. Patients with MS (PwMS) have been associated with deficits in social cognition, as shown by poor scores in ToM and expression recognition tests [5,6]. However, interactions between social cognition and QoL in MS remain less studied, whereas reports implied a relationship between poor performance on social cognition tasks and worse QoL scores [7].

ToM, a fundamental aspect of social cognition, enables individuals to infer and understand the beliefs, intentions, and emotions of others [8]. Impairments in ToM can lead to difficulties in interpreting social cues, responding appropriately in social situations, and maintaining social relationships. Emotional empathy, another key component, facilitates emotional connections by allowing individuals to recognize and share the emotions of others [9]. Additionally, social perception, which involves recognizing facial expressions, body language, and social norms, plays a vital role in guiding behavior in social contexts [2,10]. Given the pivotal role of social cognition in daily functioning, its deterioration may lead to increased social isolation, reduced social support, and heightened emotional distress, all of which can negatively impact QoL [7]. Therefore, investigating the extent to which social cognition deficits contribute to QoL impairments in MS is essential for developing holistic rehabilitation strategies that address both cognitive and psychosocial challenges faced by these patients.

The aim of this study was to investigate the relationship between social cognition and QoL in patients with MS.

2.Methods & Materials

Participants

In this prospective study, PwMS regularly monitored in the Neurology Department of the Athens Naval Hospital were included based on certain criteria. The study protocol has previously been published [11]. Inclusion criteria were the following: (1) confirmed MS diagnosis, (2) fluency in speaking Greek language, (3) age >17 years, (4) an education >3 years, (5) Expanded Disability Status Scale (EDSS) step ≤ 8, (5) availability to attend study visits, to follow researcher instructions and to answer questionnaires, (6) absence of visual problems and severe cognitive dysfunction. Accordingly, subjects were excluded in the following cases: (1) a disease relapse in at least 1 month prior to the study assessments, (2) a relapse during pregnancy, (3) use of corticosteroids, (4) presence of other comorbidities, related to fatigue, (5) active underlying infections. Approval to conduct this study was obtained by the Hospital Local Ethical Committee of the Athens Naval Hospital (6265/15 June 2020). The study procedures were in accordance to the Declaration of Helsinki and all participants provided written informed consent.

Questionnaires & Scales

All participants answered questionnaires regarding their demographic characteristics under the surveillance and guidance of researchers. Types of MS, years since diagnosis and educational level, were recorded. The functional status of the examined patients was evaluated with the EDSS, collecting evidence of 8 functional systems (pyramidal, cerebellar, brainstem, sensory, visual, bowel and bladder, cerebral and other functions of the neural system) [12]. Research material further included established in MS literature evaluation scales of QoL and social cognition. Multiple Sclerosis Quality of Life -54 (MSQOL-54) questionnaires were used to define QoL in study subjects [13]. MSQOL-54 comprises 54 items which are classified in 12 subcategories and 2 single-item questions. MSQOLS-54 score refers to 2 summary scores, a physical health- related (MSQOL-54_PHYSICAL) and a mental health- related (MSQOL-54_MENTAL), which are produced by weighted combinations of scale subscores. Furthermore, to assess social cognition in study participants, we used the "Reading the Mind in the Eyes" test (RMET) and the Faux Pas test [14–16]. In RMET, the examined subject should choose an option that best describes feelings or thoughts about every one of 36 figures

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depicting eye expressions [14]. The Faux Pas (i.e. something that should not be said) test evaluates the affective and cognitive components of the Theory of Mind (ToM), by questioning subjects to detect faux pas in 10 short scenarios [15,16]. For each test used in the present study, there are available validation studies and normative data in Greek populations [17,18](, accessed on 15 August 2023).

Statistical Analysis

Descriptive and inferential statistics were performed using IBM SPSS version 29.0 (IBM Corporation, Armonk, NY, USA). Statistical significance was set at p-value < 0.05. Shapiro-Wilk test was used to examine the normality of variables. To determine the impact of social cognition estimates and disease duration to QoL, multivariate regression models were conducted with MSQOL-54 scores as the dependent variables, and disease duration, faux pas and RMET scores as independent variables. Models of multivariate regression analysis were applied to validate statistical dependence. ANOVA with post-hoc analysis was performed to evaluate the effect of disease duration and social cognition parameters on QoL domains.

3.Results

One-hundred patients with MS were included in our study, 67 with Relapsing Remitting MS (RRMS) and 33 with Secondary Progressive MS (SPMS). Demographic and clinical characteristics of the examined subjects are summarized in Table 1, including scales measurements.

Table 1. Demographics and clinical characteristics of the study subjects.

	MS subjects n=100
Gender, male/female	39/61
Age, years median (range)	47 (20-70)
Type of MS, n	
Relapsing- remitting	67
Secondary progressive	33
Years since diagnosis, mean (sd)	11.44 (7.72)
EDSS step, median (range)	3 (1-7)
EDSS ≤ 3.5, n	72
EDSS > 3.5, n	28
MSQOL-54, mean (sd)	
Physical component	69.03 (21.58)

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Mental component	72.25 (20.14)
RMET, mean (sd)	22.78 (4.34)
Faux pas, mean (sd)	81.84 (10.68)

EDSS, expanded disability status scale; MS, multiple sclerosis; MSQOL-54, Multiple Sclerosis Quality of Life 54; RMET, Reading the Mind in the Eyes Test; sd, standard deviation.

A multivariate regression analysis was conducted to assess the predictors of physical health-related quality of life (MSQOL-54_PHYSICAL), with Faux Pas, RMET, and years since diagnosis as independent variables (Table 2). The model accounted for 20.6% of the variance in MSQOL-54_PHYSICAL scores, $R^2 = 0.206$, Adjusted $R^2 = 0.182$, $F(3, 96) = 8.321$, $p < 0.001$. The RMET score emerged as a significant predictor ($\beta = 0.336$, $p = 0.001$), indicating that higher scores on the Reading the Mind in the Eyes Test are associated with better physical QoL. Additionally, years since diagnosis was also shown as significant ($\beta = -0.225$, $p = 0.017$), suggesting that longer disease duration is associated with lower physical QoL. The Faux Pas score did not significantly predict MSQOL-54_PHYSICAL scores ($p = 0.451$).

Table 2. Multivariate Regression Analysis Predicting Physical Health-Related Quality of Life.

Variable	B	SE	β	t(96)	p	Zero-order	Partial	Part
Constant	26.250	17.430	-	1.506	0.135	-	-	-
Faux Pas	0.146	0.192	0.072	0.757	0.451	.197	0.077	0.069
RMET	1.670	0.473	0.336	3.531	**0.001**	.386	0.339	0.321
Years since diagnosis	-0.628	0.258	-0.225	-2.433	**0.017**	-.279	-0.241	-0.221

Statistical significance at $p<0.05$ (bold). RMET, Reading the Mind in the Eyes Test.

A multivariate regression analysis was performed to investigate the influence of Faux Pas, RMET scores, and years since diagnosis on the mental component of QoL (MSQOL-54_MENTAL) (Table 3). The model accounted for 13.6% of the variance in MSQOL-54_MENTAL scores, $R^2 = 0.136$, Adjusted $R^2 = 0.109$, $F(3, 96) = 5.034$, $p = 0.003$. Both Faux Pas ($\beta = 0.247$, $p = 0.015$) and RMET scores ($\beta = 0.221$, $p = 0.028$) emerged as significant predictors, indicating their positive association with mental QoL. In contrast, years since diagnosis did not significantly predict MSQOL-54_MENTAL scores ($p = 0.635$).

Table 3. Multivariate Regression Analysis Predicting Mental Health-Related Quality of Life.

Variable	B	SE	β	t(96)	p	Zero-order	Partial	Part
Constant	9.492	16.968	-	0.559	0.577	-	-	-
Faux Pas	0.465	0.187	0.247	2.482	**0.015**	0.301	0.246	0.235

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RMET	1.024	0.460	0.221	2.224	**0.028**	0.283	0.221	0.211
Years since diagnosis	0.120	0.251	0.046	0.476	0.635	-0.019	0.049	0.045

Statistical significance at $p<0.05$ (bold). RMET, Reading the Mind in the Eyes Test.

4. Discussion

Our study indicated that deficits in social cognition have a negative impact on QoL of patients with MS. The findings of this study highlight the important effect of social cognition, as measured by the RMET, on the physical aspect of QoL, and further suggest an impact of disease duration on physical health-related outcomes. Furthermore, social cognition, as assessed by both faux pas recognition and RMET scores, influence the mental health- related QoL among individuals, whereas the duration since diagnosis did not significantly contribute to this aspect of QoL.

Social cognition deficits are a consistent finding in studies of PwMS [8,19]. Dysfunction in social cognition remains less acknowledged than sensorimotor and cognitive symptoms which have been thoroughly documented; yet, the sequelae of impaired social cognition could involve PwMS in various aspects of daily life, employment, perceived anxiety and social interactions [20–22]. Alterations in core domains of social functioning could influence the level of QoL and our findings showed that social cognition deficits could directly affect QoL. It seems that these effects might be observed in all MS population and future research is pivotal. Notably, the meta-analysis by Lin et al. indicated that the magnitude of impairments in ToM and facial expression recognition was not necessarily affected by heterogeneity in clinical presentation, MS type (PPMS and SPMS) or the severity of non-social cognitive dysfunction [23].

Social cognition as a multidimensional function that encompasses various cognitive processes was found crucial for the well-being of patients [7]. In or study, this was profound in the aspect of mental health, where impairments both in emotion recognition and in the affective and cognitive elements of ToM indicated poorer mental QoL. Deficits in social cognition highlight the interplay between cognitive function and social processes, impeding the interpretation of social cues and preventing communication with others. Hence, the combination of diminished social cognition and the burden of a chronic disease like MS could lead to social isolation and poor mental QoL [24]. Given the motor symptoms of the disease as well, the duration of the disease, i.e. years since diagnosis, is a significant factor of patient-reported outcomes. In terms of QoL, it seems that longer disease duration induce greater feeling of physical disabilities. Interestingly, impairments in social cognition were shown to also affect negatively the physical component of QoL, indicating additional difficulties on daily tasks. Hence, cognitive impairment could be involved in multiple aspects of disability in MS and should be considered when analyzing patient-reported outcomes (PROs).

Our results are in agreement with previous works suggesting a direct influence of social cognition impairments on patients' QoL [25,26]. Specifically, Phillips and colleagues showed associations between impaired emotion perception and deficits in social and psychological QoL [25], whereas the work by Isernia et al. indicated an important implication of the affective component of ToM on both mental and physical QoL [26]. However, it should be noted that findings of previous studies remain controversial, since both studies by Grothe et al. [27] and Crivelli et al. [28] failed to detect significant relationships between social cognition and QoL [7]. Overlapping symptoms of fatigue, depression and anxiety may interfere with social interactions and participation in daily activities, hence, complicating the investigation of the role which social cognition has in social functioning [11]. Therefore, the causative complexity of the challenges experienced by MS patients in social interactions remains to be further studied, focusing also on developing efficient psychosocial programs to support patients [29].

The implications of these findings extend beyond the clinical assessment of MS-related cognitive dysfunction. The observed association between social cognition and QoL suggests that cognitive

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rehabilitation programs should incorporate interventions specifically targeting social cognition skills. Traditional neuropsychological rehabilitation approaches often emphasize memory, attention, and executive functioning, but there is an increasing need to develop structured training programs aimed at improving emotion recognition, ToM and social communication abilities. Furthermore, integrating social cognition assessments into routine MS evaluations may help clinicians identify patients at higher risk of social withdrawal and psychological distress. By addressing these impairments early, healthcare professionals can facilitate better social reintegration, improve interpersonal relationships, and ultimately enhance patients' overall well-being. Future research should explore whether targeted interventions, such as social cognition training or virtual reality-based social interaction programs, could serve as effective tools for improving QoL in MS patients.

Some limitations should be considered regarding this study, given its cross-sectional design. Social cognition, particularly the domains of ToM and facial emotion recognition, have been shown to be affected by impairments in various cognitive functions including IPS, working memory and executive functions [2]. However, in this study, we examined the effect of social cognition deficits on QoL, restricting investigations for other confounding factors. Furthermore, for the purposes of our study, the examined MS population was not discriminated based neither on MS type nor on gender. Finally, investigations of social cognition and QoL focused on MS subjects without including a healthy control group.

5. Conclusion

Deficits in social cognition of PwMS could directly impair both physical and mental aspects of the QoL. Future research is necessary in order to provide more robust insights, incorporating further neuropsychological and neuro-imaging data. In the era of advancements in more targeted medications to treat physical symptoms, the development of efficient social interventions is also crucial for preserving patients' well-being.

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Institutional Review Board Statement: Approval to conduct this study was obtained by the Hospital Local Ethical Committee of the Athens Naval Hospital (6265/15 June 2020).

Informed Consent Statement: The study procedures were in accordance to the Declaration of Helsinki and all participants provided written informed consent.

Data Availability Statement: All data are available upon request.

Conflicts of Interest: The authors declare no conflict of interest.

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