Multiple Sclerosis (MS) is one of the most common neurodegenerative chronic diseases of CNS which is characterized by a variety of symptoms that result from demyelination and inflammation along axons in multiple regions of the brain and spinal cord.[1, 2] The disease affects women more than twice as much as men. The age of onset ranges between 20 and 40 years.[3] MS etiology is still unknown but it is thought that MS is an autoimmune disease occurring in a genetically susceptible individual triggered by environmental factors.[4-6] Although its course is unpredictable, clinical subgroups can be identified. At clinical onset, more than 85% of MS patients experience the exacerbation symptoms followed by periods of remission in which symptoms can disappear entirely.[7, 3] This kind of form is called relapsing-remitting MS (RRMS). The other forms of MS are known as primary progressive MS (PPMS) and secondary progressive MS (SPMS).

Different areas in the brain are influenced by MS. More particularly, it produces lesions throughout the white matter, resulting in a range of neurological deficits which can affect the motor, sensory, cerebellar, cognitive, language functions, etc. Since beginning the identification of language function abnormalities in MS, the language performance evaluating provides the significant contribution to physicians in diagnosis and follow-up of the MS patients. Therefore, the aim of this study was to investigate the language aspects of MS from a linguistic perspective.

Objectives: Multiple Sclerosis (MS) is a chronic disease among the neurodegenerative disorders of the Central Nervous System (CNS). It affects the motor, sensory, cerebellar, cognitive, language functions, etc. Since beginning the identification of language functions abnormalities in MS, the language performance evaluating provides the significant contribution to physicians in diagnosis and follow-up of the MS patients. Therefore, the aim of this study was to investigate the language aspects of MS from a linguistic perspective.

Methods: The study was conducted with 35 participants diagnosed with Relapsing Remitting MS (RRMS) and 35 controls. All of the study participants were asked about their life. Phonetic, morphological, syntactic, semantic, and pragmatic features of their speech were investigated. Statistical analyses were performed using PASW Statistics for Windows, Version 18.0 (SPSS Inc., Chicago, IL, USA) and p<0.05 was considered significant.

Results: More linguistic errors were displayed by MS patients on every measure compared with the healthy subjects.

Conclusion: Speech analysis can provide additional contributions to clinicians evaluating language performance and abnormalities in patients with MS.

Keywords: Language aspects, linguistic view, multiple sclerosis
separately in order to come to a more thorough diagnosis. Simple naming and fluency tests, though revealing, do not give a complete picture of language function. These tests may have failed to identify more complex language processes. Various studies have reported naming and fluency difficulties among the population of MS. In addition, reduced speed of lexical access is another inconsistently reported linguistic deficit. Moreover, the majority of research has reported competent reading, writing, and spelling feats as well as relatively intact comprehension skills in patients with MS. Inconsistent findings among researchers make it difficult to draw tangible results about language aspects in the population of MS.

It is conceivable that the assessment of the pragmatic dimension of language, comprising the structural components of language which appears when language is used to communicate in a social context, may draw a better frame for MS language aspects than naming and fluency tests. Using common clinical measures to examine pragmatic language ability in patients with MS might help to better characterize the language aspects of this population and suggest insight regarding the confictive findings produced by standardized testing. The pragmatic use of language has been less well studied in patients with MS, how they are affected still remains poorly understood. For this reason, the present study aims to investigate the language aspects of MS and determine the language aspects derived from natural language samples through the linguistic perspective.

**Methods**

**Participants**

This study was conducted on 35 subjects (22 males + 13 females) of chronological age between 18 and 60 years. All subjects were diagnosed with RRMS according to 2010 McDonald criteria by a professional neurologist. Participants with MS had no other co-existing neurological disorders. The patients’ last attacks were before 3 months and their treatments were steroid free. The control group consisted of 35 subjects who matched the experimental group in terms of age and sex. Patients with MS were initially contacted by a neurology policlinic in order to protect patient privacy rights. All participants were native speakers of Turkish. They were reported to have neither a history of speech therapy nor a history of substance abuse. Furthermore, they were free from both past and present use of antipsychotic medication and did not use a hearing aid. Prior to the experiment, local Ethic statement was taken (protocol no: 46004091/302-14) and all participants were informed about the research then taken to the study who gave their consent.

**Data Production**

All participants were instructed to speak with the neurologist for twenty minutes about their life and background. They were also informed that the neurologist would only intervene if they began to struggle with their speech. Thus, the pragmatic language productions were almost undirected, with the participant having full freedom of speech. Whenever the participants stopped speaking for more than 5 seconds, the neurologist asked questions to encourage speech production in the participant. Open questions were preferred instead of closed questions that can be answered in a few words, so as to intervene as little as possible in the outputs of participants. In sum, the interference by the neurologist was kept as short as possible. This approach allows greater opportunity to observe an individual’s communication and also it may be ensure determining their language aspects in clinical environment.

The participants’ speeches was recorded using a digital voice recorder by the neurologist in a quiet room. Sound recordings were transcribed by the researchers according to procedures outlined in Systematic Analysis of Language Transcripts for subsequent analysis. Identification of language aspects were obtained from the transcribed and recorded data from the angle of phonology, morphology, syntax, semantics and pragmatics, respectively (Table 1).

According to linguistic perspective phonology, morphology, and syntax constitute the forms of language. Semantics states the content and pragmatics indicates the using of language (Fig. 1).

**Data Analysis**

The first step in the analyses was to create composite measures from SALT analyses. To examine the concordant language aspects between MS and healthy volunteers, linguistic measures were derived from the speech data. A linguistic composite was created by phonetic, morphologic, syntactic, semantic, and pragmatic analyses.

Statistical analyses were carried out in SPSS 18. Evaluation of descriptive datas were used the t-test, and The Mann–Whitney U test was used to search for comparing patients with MS and healthy controls. p<0.05 was considered significant.

**Results**

The study was conducted on 35 (22 male+13 female) patients with MS and 35 (15 male+20 female) healthy volunteers matched by sex, age and education. Patients with MS group had a mean age of 32.50 years (SD=8.47 years), and their ages ranged from 20 to 56 years; subjects in the control group had a mean age of 28.15 years (SD=12.10 years), with ages ranging from 18 to 52 years. The education level
for patient in the MS group was 12.6 years (SD=1.64 years),
indicating that on average, subjects had at minimum of a
high school diploma. The education level of MS patients
group ranged from 9 to 18 years. The education level for
subjects in the control group was 10.41 years (SD=2.04
years), indicating that on average, participants in the con-
trol group had a minimum of a high school degree. The ed-
cucation level of control group subjects ranged from 10 to
16 years.

In neurological examination, patients with MS disability
were assessed with the expanded disability status scale
(EDSS). The mean EDSS score for the MS subjects was 2.87
(SD=1.36) ranged from 2 to 4 (Table 2).

Analysis of the patients with MS and control groups showed
no significant difference among genders, as determined by
a chi-square (χ²) test of independence (p=0.51). Independ-
dent-samples t-tests indicated that the MS and control
group subjects were similar in age, (p=0.058), and did not
differ with regard to years of education (p=0.063).
Participants data was used to generate the SALT compos-
ites. A Linguistic composite was created with phonetic,
morphologic, syntactic, semantic and pragmatic data to
determine the language aspects of MS patients compared
to healthy subjects. The data demonstrates an uneven
spread of errors with most participants showing a slightly
high number of errors in phonetic (p=0.015), morphologic
(p=0.37), syntactic (p=0.026) and pragmatic (p=0.030) ar-
eas. This discrepancy between MS and healthy subjects
was not observed in semantic errors (p=0.745) (Table 3)."

**Discussion**

The systematic assessment of complex speech abnormali-
ties in MS has previously been limited to perceptual tests.
These tests may have failed to identify more complex
language processes. It is thought that the structural com-
ponents of language which appear when language is used
to communicate in a social context may draw a better
frame for MS language aspects. From this point of view, the
present study was to examine language aspects in sponta-
naneous speech of patients with MS and compared to healthy
controls. Speech samples were recorded from MS patients
and healthy controls. After that they were transcribed into
SALT format. First speech samples were analyzed for lin-
guistic complexity using phonetic, morphologic, syntactic,
semantic and pragmatic measures; then MS and control
groups were statistically compared. Results from speech
samples demonstrated that the MS patients displayed lin-
guistic errors relatively higher in every measure than the
healthy subjects. All these differences were found statisti-
cally significant except, interestingly, in semantic errors.

Unlike the majority of previous studies,[10, 11, 19] our findings
showed no statistically significant differences between MS
patients and healthy controls on the semantic evaluation of
speech samples, although patients with MS displayed
semantic errors slightly higher than the control partici-
pants. Recently, Ebrahimipour et al.[12] (2017) did not find
significant differences on their work which was carried out
with 90 Persian MS patients investigating semantic fluency.
Similarly, Potagas et al.[20] (2009) did not find significant
differences in a semantic word list generation task with
Greek MS patients. Nevertheless, semantic fluency and
word finding tests have also been shown to be influenced
by oral motor slowing.[10] The discrepancies in the literature
regarding the presence or absence of semantic deficits in
patients with MS are probably attributable to a wide range
of methodological differences involving sample selection
and tests employed.[21]

Speech impairment in patients with MS can sometimes be
disabling and they can manifest themselves through motor
speech aspects also known as dysarthria, voice disorders
like dysphonia, and several sound impairments.[7,9] Based
on dysarthria, MS patients can face high level phonetic
problems in daily life. The evaluation of dysarthria, by using
a noninvasive acoustic analysis of vocal signal can represent
a valid clinical support to otolaryngologists, neurologists,
and speech pathologists for early and differential diagnosis
and for documenting the disease progression.[22] Also in the
literature, clinical assessment of dysarthria in patients af-
AFFECTED by MS, have been studied and reported statistically
significant differences with respect to healthy subjects.[22, 23]
Rosen et al. (2008) researched the effects of MS on speech

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<th>Table 2. Demographic and clinical information of the subjects</th>
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<th>Table 3. SALT data analysis for patients with MS and Control groups.</th>
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<td><strong>Variables</strong></td>
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<td>Phonetic error</td>
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production and they examined whether phonetic structure matters or not. They reported that dysarthria affects the production of extremely rapid changes in vowel formants and that some phonetic structures are more useful than others for detecting these impairments. A study on expressive phonology that was carried out by Kujala (1996) demonstrated phonological deficit in patients with MS. In parallel with previous studies, our findings showed that MS patients displayed significantly greater phonetic errors when compared to the control group. In contrast to our study, Ivnik (1978) found no impairment with phonological errors when compared to the control group. In line with the previous dependent aspects of meaning go beyond the structural deficits in using pragmatic language in which the context- has been reported that MS patients could also experience pragmatic errors in their spontaneous speech. We think that pragmatic errors in MS majorly depend on cognitive impairment. Likewise, De Renzi and Vignolo (1962) pointed out that the cognitive impairment in their longitudinal study which indicated that patients with MS demonstrate deterioration in language comprehension. Similarly Arrondo et al. (2009) suggest that the pragmatic disability in MS patients arises from cognitive impairment.

**Conclusion**

In summary, patients with MS have pragmatic and structural deficits in language production, and these difficulties can be related with cognitive impairments and executive dysfunction in particular, although the possibility that dysarthria may be partly responsible for such differences cannot be disregarded. In this study, we aimed to identify language aspects of MS from a linguistic point of view. We attempted to investigate structural and pragmatic components of language aspects in MS via spontaneous speech transcriptions using SALT measurement. This measurement can ensure more contributions to clinicians when they are evaluating the language performance in MS.

Our study has, however, several limitations. The limited with sample size might also have prevented us from identifying all of the language aspects of MS. Also, a detailed analysis of language aspects using conversational or narrative speech measures may demonstrate other differences between patients with MS and healthy subjects. Future studies may concentrate on the development of more sensitive testing measures, both formal and informal, to identify the language aspects of MS and the use of larger sample sizes having a wider range of severity.

**Disclosures**

**Ethics Committee Approval:** The study was approved by the Local Ethics Committee (Protocol no: 46004091/302-14).

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** None declared.


**References**

2. Mackenzie C, Green J. Cognitive-linguistic deficit and speech