Multiple sclerosis, the decision to become pregnant, and factors associated with perinatal relapse

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Abstract

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Background: Multiple sclerosis (MS) is one of the most common diseases of the nervous system, impacting more than two million people worldwide. Over 400,000 individuals in the United States are diagnosed with MS each year. MS diagnosis is more common (two to three times more) among women than men and it is most commonly diagnosed during the second and third decades of life, prime reproductive years for many women. While research has shown that a diagnosis of MS does not decrease a woman's ability to have children, the MS diagnosis and pregnancy experience after MS diagnosis may influence the decision to have children. Further, pregnancy may have an impact on the course of MS.

Methods: The study was conducted in the setting of the Greater Washington Chapter of the National Multiple Sclerosis Society (NMSS). The current study was conducted among 391 women, community-dwelling participants with MS, who responded to survey questions related to pregnancy and MS. Study participant characteristics (e.g. socio-demographic characteristics), opinion on pregnancy-related decision making, and experience of MS relapse during the perinatal period were summarized using descriptive statistics. Differences in characteristics between women who experienced perinatal MS relapse and women who did not were compared using Student's T-test and Chi-square tests.

Results: The mean age of participants was 52 years. Of the women who participated in the survey, 67 (17.1%) had at least one pregnancy after their MS diagnosis. Women who experienced pregnancy after MS diagnosis were younger at MS diagnosis (28 vs. 40 years) and of lower body mass index (25 vs. 27

kg/m^2), compared with women who did not experience pregnancy after MS diagnosis (all p-value<0.05). Married women were more likely to have a pregnancy after their MS diagnosis (80% vs. 67%). Of the women who did become pregnant after their diagnosis, 39.7% indicated that their pregnancy experience influenced their decision to have more children. Of the pregnant women, 36 (53.7%) reported experiencing an MS relapse either during pregnancy (N=2), after delivery (N=26), or both time periods (N=7). Perinatal relapse of MS was potentially related to the course of MS and the marital status of women.

Conclusion: Age at MS diagnosis and body mass index are related to experiencing pregnancy after MS diagnosis. MS diagnosis contributes to pregnancy-decision making. Course of MS and marital status are potentially related to perinatal MS relapse. Similar future studies can further our understanding of the relationships between MS diagnosis, pregnancy-decision making, and factors related to perinatal MS relapse, contributing to improved clinical care and development of preventative strategies to reduce MS related burden during the perinatal period.

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DEDICATION

This thesis was written in dedication to my mother, Danye'l Afonso, who was diagnosed with Multiple Sclerosis in 2006 and has never once let this diagnosis slow her down. Thank you, Mom, for all your support, and for being the greatest role model.

BACKGROUND

Recognized in the late 1800's by neurologists around the world, multiple sclerosis (MS), is a disabling disease of the central nervous system (brain and spinal cord)[1] with unknown etiology. The immune system of an individual diagnosed with MS attacks the protective sheath (myelin) that covers nerve fibers and causes an interruption in communication between the brain and the rest of the body[2]. In addition, MS leads to deterioration and permanent damage of the nerves [2]. Neurologic symptoms associated with MS include vision loss, paralysis, numbness, and walking difficulties[2]. Due to the diverse and non-specific symptoms, which often come and go without any pattern, diagnosis of MS is difficult. There are four courses of MS that are characterized by different patterns of clinical progress and relapse of the central nervous system demyelination: Clinically isolated syndrome (CIS), Relapsing-Remitting MS (RRMS), Primary-Progressive MS (PPMS), and Secondary-Progressive MS (SPMS).

MS is one of the most common diseases of the nervous system. Worldwide, MS impacts 2.5 million people with 400,000 of diagnosed individuals residing in the United States[3]. In the US, the prevalence of MS is approximately 90 per 100,000[3]. Additionally, MS is the most frequent non-traumatic disabling neurologic disease among young adults with 12,000 new diagnoses per year in the United States alone[4]. MS is more frequent in women (two to three-fold) than men, and among residents of regions more distant from the equator[4,5]. The disease is diagnosed usually during the second and third decade of a person's life (25-30 years)[6], the prime reproductive years for many women. While research has shown that a diagnosis of MS does not decrease a women's ability to have children[7], an MS diagnosis and pregnancy experience after MS diagnosis may influence the decision to have children and pregnancy may have an impact on the progression of the disease. Given the high prevalence of MS in reproductive age women,

understanding factors that contribute to pregnancy decision making and/or factors that are related to perinatal relapse is important.

Previous literature has been able to identify common themes that are associated with the pregnancy decision making process such as, "concerns about the mother's own health and well-being", "well-being of the child", "coping with parenting", "societal attitudes", and "experiencing parenting"[8]. In addition, the decision to become pregnant among women with MS involves consideration of multiple factors such as financial stability and security, support from family and/or friends, and the availability of resources. With such uncertainties that relate to the impact pregnancy has on the progression of MS and the impact of MS on the course of pregnancy, women may have difficulty in making the decision to become pregnant after MS diagnosis. Further, previous observations of progression and/or digression of the disease during and after pregnancy were inconsistent, warranting further investigations on contributing factors. The goal of the current study, conducted among women with a diagnosis of MS in the state of Washington, was to help fill these gaps in the literature. Findings will enhance understanding of potential pregnancy decision factors as well as factors that contribute to MS relapse during the perinatal period.

METHODS

Study Setting

The study was conducted in the setting of the Greater Washington Chapter of the National Multiple Sclerosis Society (NMSS), which serves 23 counties in Washington State. Reports from survey-based studies in this setting have previously been published on cognitive aids and other assistive technology[9], the prevalence of sleep problems[10], as well as the

experiences and perspectives of pregnancy[11]. Briefly, invitations to participate in the parent survey-based study were sent to 7,806 individuals identified from the NMSS mailing list with self-identified MS. The eligibility requirements for the parent study included having a definitive diagnosis of MS by a physician and be at least 18 years of age. A total of 1,477 participants responded to the request, and of these, 1,362 were eligible for the study. Recruited study participants filled a self-report survey in 2008. All research participants provided informed consent prior to participation and study procedures were approved by the human subject's division of the University of Washington.

Study Participants

The current study was conducted among a convenience sample of 391 women, community-dwelling participants with MS, who responded to additional survey questions related to pregnancy and MS. Among participants who responded to the additional survey questions, 86 (22.2%) women were never pregnant, 321 (82.73%) women had pregnancy before their MS diagnosis, and 67 (17.27%) women had pregnancy after MS diagnosis. The analytic sample for the current report comprised of these 67 participants who had pregnancy after MS diagnosis.

Data Collection

Data was collected using participant-filled mailed surveys. The survey contained questions on demographics, psychosocial, and function or disease specific characteristics, including socio-demographic characteristics, such as age, age at MS diagnosis, body mass index, identified MS course, race, education, marital status, and household income as well as questions related to fertility including whether they experienced difficulty in becoming pregnant, discussing fertility with a physician and/or specialist, miscarriages, and, medical history (such as

a diagnosis of endometriosis and/or polycystic ovarian syndrome). In addition to general questions about fertility, women were also asked about MS relapse during pregnancy and/or within the first 6 months after delivery and whether their diagnosis of MS influenced their attitude about having more children. More specifically, we used the following questions to query opinion related to pregnancy after MS diagnosis: "Did the experience of your first pregnancy after being diagnosed with MS, influence your attitude about having more children?" , "My partner and/or I felt reassured that we can have children despite having MS", "My partner and/or I were more concerned, but still attempted to have more children", "My partner and/or I chose to not become pregnant again", "My partner and/or I chose to adopt children", and "Other".

We also asked whether participants had an MS relapse either during their pregnancy and/or six-months after delivery. An MS relapse was defined as "the occurrence, the recurrence, or the worsening of symptoms of neurologic dysfunction that lasted more than 24 hours and that stabilized or eventually resolved either partially or completely[12]". Four known courses of MS were defined as follows: Clinically Isolated Syndrome (CIS), Relapsing Remitting (RRMS), Primary Progressive (PPMS), and Secondary Progressive (SPMS)[13]. CIS refers to a first episode of neurologic symptoms that lasts at least 24 hours and is caused by inflammation or demyelination (the loss of the myelin that covers the nerve cells) in the central nervous system (CNS). RRMS, the most common type (85%), is distinguished by clearly defined attacks of new or increasing neurologic symptoms[14]. Attacks, also referred to as relapse or exacerbations, are followed by periods of partial or complete remission. During remission, all symptoms may disappear, or some symptoms may continue to become permanent[14]. In this type of MS, no apparent progression of the disease is observed during periods of remission. PPMS, is characterized by worsening neurologic function and accumulation of disability starting from the

onset of symptoms without early relapses or remissions. SPMS, follows a relapse-remitting course but with a progressive worsening of neurologic function over time[14].

Statistical Analyses

Study participant characteristics were summarized using mean (standard deviations) for continuous variables, and, number (percentage, %), for categorical variables. We summarized these characteristics among groups of women who were pregnant after MS diagnosis and among women who were not pregnant after MS diagnosis. Differences between the two groups were evaluated using Student's T-test for continuous variables and Chi-square tests for categorical variables. Responses (yes/no) to survey questions on pregnancy-related decision making opinion were summarized using number (%).We examined differences in selected characteristics between women who had or did not have perinatal MS relapse using Student's T-test for continuous variables and Chi-square tests for categorical variables. Statistical significance was determined at $p<0.05$. Analyses were conducted using STATA 14.2 (STATA, College Station, TX).

RESULTS

Overall, 92.29% (n=359) of participants were Non-Hispanic White, 1.54% (n=6) were Non-Hispanic Black, and, 2.06% (n=8) were Hispanic. A combined percentage of 1.8% (n=7) self-identified as either Non-Hispanic American Indian Alaska Native, Non-Hispanic Asian, or Hispanic plus another race; and, about 2.31% (n=9) were of more than one race (**Table 1**). The mean age of participants was 52 years (52.03 ± 10.87) and the mean age at MS diagnosis was 38 years (38.38 ± 10.09). Most participants (57.8%) have finished some college or graduated with a college degree. About 69% of participating women were married or living with their partner.

Three of the four courses of MS illness were represented in the study population with 61.8% of women having the RRMS course.

Of the women who participated in the survey, 67 (17.1%) had at least one pregnancy after their MS diagnosis (**Table 2**). These women had a mean age of 47 years (47.34±12.23 years), whereas 321 (82.1%) women who did not have pregnancy after MS diagnosis had mean age of 52 years (52.92 ± 10.33 years) ($p<0.000$). The mean age at MS diagnosis for women who had subsequent pregnancy were lower (27.86 ±6.47years) compared with the mean age at MS diagnosis (40.49±9.33 years) for women who did not experience pregnancy after MS diagnosis ($p<0.000$). Similarly, women who experienced pregnancy had lower body mass index (25.46 ±6.01 years) compared with women who did not experience pregnancy (27.11±5.79 years) ($p=0.018$). In addition, the proportion of women who were married among women who experienced pregnancy was higher than the proportion of women who were married among women who did not experience pregnancy (80.60% vs. 66.67%, $p=0.025$).

Results of the survey on opinion on pregnancy among study participants who were pregnant after being diagnosed with MS are shown in **Table 3**. Of the women who did become pregnant after their diagnosis, 39.66% indicated that their pregnancy experience influenced their decision to have further children. In combination of responses, these women noted that they "felt reassured about having children despite having MS" (39.13%), "were more concerned, but still attempted to have more children" (13.04%), and, "chose to not to become pregnant again" (39.13%).

Among women who were diagnosed with MS, 28 (41.8%) women reported having no MS relapse during the pregnancy or the first six months after delivery, and 36 (53.7%) women

reported experiencing an MS relapse either during pregnancy (N=2, 5.6%), after delivery (N=26, 72.2%), or both (N=7, 19.4%) (**Tables 4 and 5**). Although differences in the incidence of MS relapse were observed according to MS disease course and marital status, the differences were not statistically significant (p=0.068 and p=0.092, respectively). Higher percentage of participants with relapse had SPMS compared with similar percentage among women who did not have relapse (25% vs. 11%, p-value=0.068). Similarly, higher percentage of participants with relapse were unmarried compared with percentage of participants who were married in the group with no relapse (22% vs. 11%, p-value=0.092). We did not see significant differences in characteristics between participants who had relapse at the different time periods in relation to the pregnancy.

DISCUSSION

In this study, we investigated women who became pregnant after their MS diagnosis to evaluate pregnancy-related decision factors after MS diagnosis and risk factors associated with perinatal relapse. Among women who had pregnancy after MS diagnosis, about 40% had their pregnancy opinions influenced by their pregnancy experience after MS. Compared with women who did not experience a pregnancy after their MS diagnosis, those who experienced pregnancy were younger at MS diagnosis and at the time the survey was taken. Women who experienced a pregnancy after their MS diagnosis also had lower body mass index and tend to be married. Perinatal relapse of MS is potentially related to the course of MS and the marital status of women.

More than a third of our study participants who experienced pregnancy after MS diagnosis indicated that their attitude towards further pregnancy is affected by their experience. The responses to the set of questions on pregnancy opinion put into perspective the amount of

influence a diagnosis of MS has on women when making the decision to become pregnant. It also indicates the level of knowledge women had about MS and the amount of information available surrounding MS and pregnancy. This underlines the importance of women's discussion with their providers about their MS diagnosis and their decision to become pregnant through opportunities that address misconceptions and/or inform the family.

In comparisons of women who became pregnant after their MS diagnosis and women who did not become pregnant after their diagnosis, women who were diagnosed at an older age were less likely to have a pregnancy after diagnosis, as well as women who were classified as having a higher BMI. Age is probably a factor that is considered when making the decision to become pregnant after a diagnosis. Weight may be a factor because it has been related to success of pregnancy[15]. Furthermore, women who had MS and were married were more likely to have a pregnancy after their MS diagnosis. While not surprising, this result suggests that having a close support system is a potential factor in making the decision to become pregnant for women who have been diagnosed with MS. Other factors that may contribute to the decision of becoming pregnant experience of pregnancy include severity of disease, MS course and related symptoms, as well as additional factors such as other health conditions, weight, location, having a support system and resources.

Previous research indicates that MS disease activity is reduced during the last trimester of pregnancy and rapidly increases within the period that spans between 3-months to 6-months after the end of pregnancy[7]. Neuteboom et al., reported that in the third trimester (mean relapse per woman = 0.2 ± 1.0), MS relapse rate is decreased by 70% compared to the rate of relapse (mean relapse per woman = 0.7 ± 0.9) in the year preceding pregnancy)[16]. Yet in the first 3-months after delivery, one in every three women has a relapse[17]. A 2011 systematic review by Finkelsztejn et

al., evaluated 13,144 women (22 studies) with MS and their pregnancies[18]. In that study, before pregnancy, participating women had 0.435 ± 0.021 relapses/year. During the pregnancy, relapse rate decreased to 0.260 relapses/year (0.182 ± 0.012) and after delivery, the relapse rate showed a substantial increase to 0.758 relapses/year (0.703 ± 0.024)[18]. This is similar to our observation that 33 of the 35 relapse cases happened either during the 6-months after delivery or both during delivery and the 6-month period after delivery. About 50% of our participants who experienced relapse during the perinatal period. Comparisons between women who had MS relapse during the perinatal period to those who did not have a relapse suggests that course of MS and marital status are related to occurrence of MS relapse. The information provided in this analysis can aide in identification of populations at high-risk for MS relapse, and develop preventative strategies to minimize the effects of this disabling disease.

Several limitations of the study deserve mention. Study participants were mostly non-Hispanic White and the lack of diversity among the survey participants may limit generalizability of findings to a larger, diverse population. In addition, our analyses involved participants from mostly northern states. To the extent that socio-demographic, cultural, and biologic characteristics differ between northern and southern states, results may also not be generalizable to MS cases in the southern states. Additionally, due to the limited number and depth of questions on fertility and experience during pregnancy, we could not conduct detailed analyses to address all relevant issues. The sample size of the study was low minimizing study power. Our assessment of body mass index was done at the time of the survey and not before the pregnancy. Finally, given the convenience sampling, we cannot rule out bias (selection bias) in our study. Studies that are well-designed and have adequate power are needed to address these limitations.

Clarity of the effect of MS on pregnancy and vice versa, as well as, adequate communication of this to patients will reduce uncertainty and anxiety among women with MS when making the decision to become pregnant. Understanding the impact of risk factors that contribute to relapse and progression of MS during and after pregnancy will allow neurologists and obstetricians provide the best care for their patients while it allows public health researchers identify and design preventative strategies to reduce MS related burden during the perinatal period.

Table 1: Selected characteristics of study participants with multiple sclerosis (MS)

Characteristics	Total (N=391)
Age, years	*(52.03 ± 10.87)
< 31 years	15(3.84)
32 – 42 years	58(14.83)
43 – 53 years	143(36.57)
54 – 64 years	132(33.76)
> 65 years	43(11.00)
Age at MS Diagnosis, years	*(38.38 ± 10.09)
< 20 years	10(2.56)
21 – 30 years	88(22.51)
31 – 40 years	128(32.74)
41 – 50 years	117(29.92)
> 51 years	48(12.28)
BMI	*(26.78 ± 5.85)
Underweight	10 (2.59)
Normal Weight	165 (42.75)
Overweight	120 (31.09)
Obese	91 (23.58)
MS Course	
Relapsing Remitting	238(61.82)
Secondary Progressive	77(20.00)
Primary Progressive	40(10.39)
Progressive Relapsing	30(7.79)
Race	
Non-Hispanic White	359(92.29)
Non-Hispanic Black	6(1.54)
Non-Hispanic AI/AN	1(0.26)
Non-Hispanic Asian	3(0.77)
Hispanic	8(2.06)
Hispanic + Other Race	3(0.77)
More than One Race	9(2.31)
Education	
9^{th} Grade or Less	1(0.26)
Some High School	3(0.77)
HS Graduate or GED	53(13.55)
Vocational or Tech School	40(10.23)
Some College	114(29.39)
College Graduate	111(28.39)
Graduate School/Prof School	69(17.65)
Marital Status	
Married/Living w/ Partner	269(68.80)
Separated	5(1.28)

Divorced	60(15.35)
Never Married	19(4.86)
Widowed	12(3.07)
Single	21(5.37)
Other	5(1.28)
Household Income	
Less than $25,000	72(18.41)
$25,000 - $40,000	53(13.55)
$41,000 - $55,000	52(13.30)
$56,000 - $70,000	52(13.30)
$71,000 - $85,000	29(7.42)
$86,000 - $100,000	46(11.76)
Greater than $100,000	58(14.83)
Decline to Answer	29(7.42)

*mean (standard deviations), otherwise n(%)
Abbreviations: Body Mass Index (BMI), American Indian / Alaska Native (AI/AN),
Percentages (%) may not add up due to missing values.

Table 2: Selected characteristics of study participants by history of pregnancy after multiple sclerosis (MS) diagnosis

Characteristics	Women who were pregnant after MS Diagnosis(n=67)	Women who were not Pregnant after MS Diagnosis(n=321)	P-value **
Age, years	*(47.34 ± 12.23)	*(52.92 ± 10.33)	**<0.000**
≤ 30 years	6 (8.96)	3 (0.93)	**<0.000**
>31 years	61 (91.04)	318 (99.07)	
Age at MS Diagnosis, years	*(27.86 ± 6.47)	*(40.49 ± 9.33)	**0.000**
≤ 30 years	46 (68.66)	52 (16.20)	**<0.000**
>31 years	21 (31.34)	269 (83.80)	
BMI	*(25.46 ± 6.01)	*(27.11 ± 5.79)	**0.018**
Underweight	3 (4.48)	7 (2.22)	
Normal Weight	34 (50.75)	128 (40.51)	0.210
Overweight	19 (28.36)	101 (31.96)	
Obese	11 (16.42)	80 (25.32)	
MS Course			
Relapsing Remitting	47(71.21)	190(60.13)	
Secondary Progressive	12(18.18)	64(20.25)	0.301
Primary Progressive	4(6.06)	36(11.39)	
Progressive Relapsing	3(4.55)	26(8.23)	
Race			
Non-Hispanic White	61(91.04)	295(92.48)	
Non-Hispanic Black	2(2.99)	4(1.25)	0.580
Other	4 (5.97)	20 (6.27)	
Education			
High School Graduate or Less	8 (11.94)	48 (14.95)	
Vocational/Some College	20 (29.85)	134 (41.74)	0.082
College Graduate or More	39 (58.21)	139(43.30)	
Marital Status			
Married	54 (80.60)	214 (66.67)	**0.025**
Not Married	13 (19.40)	107 (33.33)	
Household Income			
Less than $25,000	11 (16.67)	66 (21.15)	
$25,000 - $85,000	35 (53.03)	165 (52.88)	0.630
Greater than $85,000	20 (30.30)	81 (25.96)	

*mean (standard deviations), otherwise n(%)

Percentages (%) may not add up due to missing values.

**P-values for Students t-test (continuous variables), or Chi-square tests (categorical variables).

Abbreviations: Body Mass Index (BMI), American Indian / Alaska Native (AI/AN), Civilian Health and Medical Program of the Uniformed Services (CHAMPUS), Social Security Disability (SS Disability), Supplemental Security Insurance (SSI)

Table 3: Opinion on pregnancy among study participants who were pregnant after being diagnosed with multiple sclerosis (MS)

Questions	Responses
	Yes
"Did the experience of your first pregnancy after being diagnosed with MS, influence your attitude about having more children?"	**23* (39.66)**
"My partner and/or I felt reassured that we can have children despite having MS"	9 (39.13)
"My partner and/or I were more concerned, but still attempted to have more children"	3 (13.04)
"My partner and/or I chose to not to become pregnant again"	9 (39.13)
"My partner and/or I chose to adopt children"	0 (0)
"Other"	20 (86.96)

*Number (percent) for the categories below were calculated among the 23 who responded affirmatively to this question
Percentages (%) may not add up due to missing values.

Table 4: Selected characteristics of study participants who became pregnant after multiple sclerosis (MS) diagnosis (N=64) according to MS relapse status

Characteristics	No Relapse (N=28)	Relapse (N=36)	P-value**
Age	*(47.34 ± 12.23)	*(47.34 ± 12.23)	0.616
≤ 30 years	3 (10.71)	3 (8.33)	0.746
> 31 years	25 (89.29)	33 (91.67)	
Age at MS Diagnosis	*(27.86 ± 6.47)	*(27.86 ± 6.47)	0.395
≤ 30 years	18 (64.29)	26 (72.22)	0.497
> 31 years	10 (35.71)	10 (21.78)	
BMI	*(25.45 ± 6.01)	*(25.45 ± 6.01)	0.612
Underweight	--	2 (5.56)	0.425
Normal Weight	17 (60.71)	16 (44.44)	
Overweight	7 (25.00)	12 (33.33)	
Obese	4 (14.29)	6 (16.67)	
MS Course			
Relapsing Remitting	19 (67.86)	25 (69.44)	0.068
Secondary Progressive	3 (10.71)	9 (25.00)	
Primary Progressive	3 (10.71)	1 (3.78)	
Progressive Relapsing	3 (10.71)	--	
Race			0.730
Non-Hispanic White	26 (92.86)	32 (88.89)	
Non-Hispanic Black	1 (3.57)	1 (2.78)	
Other	1 (3.57)	3 (8.33)	
Education			0.300
High School Graduate or Less	4 (14.29)	3 (8.33)	
Vocational/Some College	6 (21.43)	14 (38.89)	
College Graduate or More	18 (64.29)	19 (52.78)	
Marital Status			0.092
Married	25 (89.29)	26 (72.22)	
Not Married	3 (10.71)	10 (21.78)	
Household Income			0.364
Less than $25,000	4 (14.29)	7 (19.44)	
$25,000 - $85,000	13 (46.43)	20 (55.56)	
Greater than $85,000	11 (39.29)	8 (22.22)	

*mean (sd), otherwise n(%)

Percentages (%) may not add up due to missing values.

**P-values for Students t-test (continuous variables), or Chi-square tests (categorical variables).

Table 5: Selected characteristics of study participants who became pregnant after multiple sclerosis (MS) diagnosis (N=64) according to MS relapse timing

Characteristics	No Relapse (n = 28)	Relapse During Pregnancy (n=2)	Relapse Within 6-months After Delivery (n=26)	Relapse During Pregnancy and within 6-months After Delivery (n=7)	P-value**
Age					
≤ 30 years	3(10.71)	--	2 (7.69)	1 (14.29)	0.910
>31 years	25(89.29	2 (100.00)	24 (92.31)	6 (85.71)	
Age at MS Diagnosis					
≤ 30 years	18 (64.29)	1 (50.00)	19 (73.08)	5 (71.43)	0.844
>31 years	10 (35.71)	1 (50.00)	7 (26.92)	2 (28.57)	
BMI					
Underweight	--	--	1 (3.85)	1 (14.29)	0.513
Normal Weight	17 (60.71)	2 (100.00)	11 (42.31)	2 (28.57)	
Overweight	7 (25.00)	--	9 (34.62)	3 (42.86)	
Obese	4 (14.29)	--	5 (19.23)	1 (14.29)	
MS Course					
Relapsing Remitting	19 (67.86)	1 (50.00)	18 (69.23)	5 (71.43)	0.531
Secondary Progressive	3 (10.71)	1 (50.00)	6 (23.08)	2 (28.57)	
Primary Progressive	3 (10.71)	--	1 (3.85)	--	
Progressive Relapsing	3 (10.71)	--	--	--	
Race					
Non-Hispanic White	26 (92.86)	2 (100.00)	23 (88.46)	6 (85.71)	0.950
Non-Hispanic Black	1 (3.57)	--	1 (3.85)	--	
Other	1 (3.57)	--	2 (7.69)	1 (14.29)	
Education					
High School Graduate or Less	4 (14.29)	--	3 (11.54)	--	0.737
Vocational/Some College	6 (21.43)	1 (50.00)	10 (38.46)	3 (42.86)	
College Graduate or More	18 (4.29)	1 (50.00)	13 (50.00)	4 (57.14)	
Marital Status					
Married	25 (89.29)	2 (100.00)	18 (69.23)	6 (85.71)	0.246
Not Married	3 (10.71)	--	8 (30.78)	1 (14.29)	
Household Income					
Less than $25,000	4 (14.29)	1 (50.00)	5 (19.23)	--	0.118
$25,000 - $85,000	13 (46.43)	--	13 (50.00)	7 (100)	
Greater than $85,000	11 (39.29)	1 (50.00)	7 (26.92)	--	

* n(%)

Percentages (%) may not add up due to missing values.

**P-values for Chi-square tests (categorical variables).

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