INTRODUCTION

Multiple sclerosis (MS) is the most common chronic inflammatory, demyelinating and neurodegenerative disorder of the central nervous system (CNS) to affect young adults. The disease course is characterized by long survival and increasing disability over time, imposing a major burden on the patient, their family and people in their social networks. As with other chronic conditions, MS is a collective phenomenon that creates increasing care needs, makes heavy demands on coping abilities and raises issues of dependency.

Objective: To evaluate the association between social capital (SC) and the physical and psychological impact of multiple sclerosis (MS).

Materials & Methods: A cross-sectional study was conducted among people with MS (pwMS) at The Royal London Hospital, London, UK. Participants completed a survey including the Multiple Sclerosis Impact Scale-29 (MSIS-29), the Hospital Anxiety and Depression Scale (HADS), the self-reported EDSS and a SC questionnaire (SCQ). The SCQ assessed personal relationships, social support networks, civic engagement, and trust and cooperative norms. Kendall's tau correlation test was performed to measure the correlation between SC and MSIS-29 scores, and multiple linear regressions were conducted to find the best outcome prediction model.

Results: 236 pwMS participated in the study. Median age was 43.5 years (IQR 35-52). Of the total, 168 (71.2%) were female and 180 (76.3%) had relapsing-remitting MS. Median MSIS-29 scores were 23.7 (IQR 8.8-57.5) for the physical scale and 38.9 (IQR 16.7-55.6) for the psychological scales. Total SC scores were significantly correlated with the MSIS-29 physical ($\tau_b = -0.09$, $P = .02$) and psychological scores ($\tau_b = -0.23$, $P < .001$). After adjusting for possible confounders, the "personal relationships" domain had a significant effect on the MSIS-29 physical scores ($\beta = -2.70$, SE = 1.34; $P = .045$). Total SC ($\beta = -1.08$, SE = 0.33; $P = .001$) and the "personal relationships" ($\beta = -2.60$, SE = 1.20; $P = .031$) and "trust and cooperative norms" ($\beta = -1.40$, SE = 0.61; $P = .024$) domains had a significant effect on the MSIS-29 psychological scores.

Conclusions: Higher levels of SC were associated with lower physical and psychological impact of MS. Emerging evidence on SC and its effects on MS should be translated into interventions designed to promote the health and well-being of pwMS.

KEYWORDS
multiple sclerosis, patient-reported outcome measures, social capital, social determinants of health, social support
Therefore, social relationships of people with MS (pwMS) are at risk of stress and disruption. A 2018 MS society report showed that 60% of surveyed patients felt isolated or lonely as a result of MS.

Social factors have a powerful role in shaping health across a wide range of health indicators, settings and populations. There is a growing body of evidence that social isolation leads to inflammation, oxidative stress, increased microglial activity and neurodegeneration. Social stress-induced neuroinflammation has been associated with motor impairments, sickness behaviours and impaired hippocampal-dependent memory consolidation in an animal model of MS. The presumed mechanism involves a social stress-induced increase in the pro-inflammatory cytokine interleukin-6, which primes the CNS to an enhanced innate immune response and disrupts the adaptive CNS immune response.

These findings are in line with clinical observations that pwMS is embedded in social structures that may affect their outcomes. Social support has been shown to modulate the effect of stress on immune function and inflammation in pwMS. Existing literature also suggests that supportive relationships are critical in helping pwMS to cope with their disease and is associated with a higher quality of life (QOL), leads to better mental health and influences adherence to disease-modifying therapies (DMTs). Conversely, social isolation is a predictor of depression and suicidal intent among pwMS.

Social capital (SC) refers to the many resources derived from the social interaction between individuals and groups. It can be considered as a by-product of social relationships that facilitates coordination and cooperation for mutual benefit. Social capital is shaped by people’s visible networks and informal elements of trust and reciprocity within a community. Although the impact of SC on health and mortality has been well documented, its precise role in neurology is just beginning to be elucidated. Previous studies have reported that SC contributes to executive function recovery after paediatric traumatic brain injury, mitigates the effect of stressful life events on cognitive decline, and plays a role in sleep quality. In addition, SC has been inversely associated with depressive and anxiety symptoms and has been found to be a stronger predictor of mental well-being.

Although these findings suggest that SC can have a profound effect on the health of patients with neurological disorders, data specific to pwMS are very scarce. The available evidence suggests that SC may also contribute to better health outcomes and QOL in pwMS. As has occurred with other chronic conditions, a better understanding of the relationship between SC and MS outcomes may help clinicians to better integrate SC and health promotion in MS clinical practice.

The objective of this study was to evaluate the association between SC and the physical and psychological impact of MS.

2 | METHODS

2.1 | Patients

A cross-sectional study was conducted among 236 pwMS at the Royal London Hospital (RLH) Barts Health NHS Trust in London, United Kingdom (UK). Patients with either relapsing-remitting (RR), secondary progressive or primary progressive MS were contacted by email between September 2017 and March 2018. Inclusion criteria were age ≥18 years and a clinically definite diagnosis of MS according to McDonald criteria. Eligible participants were emailed an online link to complete all study procedures, including outcome assessment measures. Ethical approval was not sought as all data used were collected as part of a clinical audit registered with the hospital audit committee (ID: 8520). The study was conducted in accordance with the ethical principles in the Research Governance Framework for Health and Social Care, Second Edition (2005) and its subsequent amendments. Routine de-identified clinical data were collected and stored as per local Trust policies in accordance with the principles of the Data Protection Act.

2.2 | Measurements

2.2.1 | Social capital

Social capital was measured using the Office for National Statistics (ONS) harmonized question set from the 2017 “SC in the UK” statistical bulletin. The ONS SC questionnaire has been used to measure and monitor SC as part of the UK Measuring National Well-being Programme, and it is the set of questions that the ONS recommends to measure SC in the UK. The questionnaire includes 23 headline indicators of SC, distributed in four domains: personal relationships (5), social support networks (4), civic engagement (7) and trust and cooperative norms (7). Responses were dichotomized (Yes/No) for meeting the ONS indicator criteria, and the SC domains were expressed as the number of indicators fulfilled per patient. A total SC score was also constructed into an additive scale ranging from 0 to 23.

2.2.2 | Impact of MS

Patients were asked to complete the Multiple Sclerosis Impact Scale-29 (MSIS-29). The MSIS-29 is a disease-specific, self-reported questionnaire for measuring the physical and psychological impact of MS via two scales of 20 (MSIS-29-PHYS) and 9 (MSIS-29-PSYCH) items, respectively. Each item is rated on a 5-point Likert-like scale from “not at all” to “extremely,” and scores are added and transformed to a 0-100 scale. Separate summary scores are obtained for each of the MSIS-29-PHYS and MSIS-29-PSYCH scales, with higher scores indicating greater impact of MS. The psychometric properties of the MSIS-29 have been well established.

2.2.3 | Covariates

Data were obtained on patient demographics, disease characteristics and potential confounding factors from the electronic clinical
record system of the RLH. Independent variables included age, sex, race, type of MS, DMTs, disease duration and disability. Disability was measured using the Expanded Disability Status Scale (EDSS); possible range, 0-10, with a higher score indicating a greater degree of disability. Potential confounding factors included anxiety and depression, marital status, living arrangements, years living in their current residence, education, employment and income. Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS), which is a 14-item instrument for measuring psychological distress with separate anxiety (HADS-A) and depression (HADS-D) subscales. Each item is scored in a Likert fashion from 0 to 3, which gives a range of scores from 0 to 21 on each subscale. An optimal balance between sensitivity and specificity has been found using a cut-off score of ≥8 for both HADS-A and HADS-D. The use of these cut-off values to classify depression or anxiety has been validated in MS. Patient income was extracted from the English Index of Multiple Deprivation (IMD) using the Ministry of Housing, Communities and Local Government postcode lookup tool portal. IMD is an area-based measure, which combines information on different domains of deprivation, including income. IMD data are classified into deciles, with decile 1 representing the 10% most deprived areas in the country and decile 10 representing the 10% least deprived ones.

2.3 | Statistical analysis

Categorical variables were reported as frequency and percentage while continuous variables were reported as median and interquartile range (IQR). All continuous variables were tested for normality using the Shapiro-Wilk test. Kendall's tau correlation test was used to assess correlation between SC and the MSIS-29-PHYS and MSIS-29-PSYCH scores. Then, a linear regression was used to estimate the association between all covariates and the MSIS-29-PHYS and MSIS-29-PSYCH scores. Categorical variables were coded into dummy variables for inclusion in regression analyses. Independent variables that were significantly associated with MSIS-29-PHYS and MSIS-29-PSYCH scores were included in stepwise fashion into a multiple linear regression model to account for confounding factors and to find the best model fit that would predict the outcomes of interest. Independent variables were added one at a time based on individual models in order from largest to smallest McFadden's pseudo-R squared. Regression coefficients were reported for the most parsimonious model that best described the association between SC and the MSIS-29-PHYS and MSIS-29-PSYCH scores. Multicollinearity between predictor variables was assessed using the variance inflation factor and tolerance statistics, while the assumption of independent errors was assessed using the Durbin-Watson test. Normality and homoscedasticity assumptions were met for all linear models. P-values were based on two-sided tests of significance, and statistical significance was established at P < .05. All analyses were performed using the statistical package R.

3 | RESULTS

Of the 431 participants invited to participate, 236 (55%) completed the survey. Among those who were recruited, the median age was 43.5 years (IQR 35-52), 168 (71.2%) were female and 180 (76.3%) had RR MS. The median EDSS was 4 (IQR 2.5-6.5), and the median disease duration was 8 years (IQR 4-13). 134 (56.8%) participants were married, and 190 (80.5%) were living with their family and/or friends. The median income decile was 5 (IQR 3-7.8), and 190 (80.5%) individuals had completed higher education. The median HADS score for anxiety was 8 (IQR 4.75-11.25) and for depression was 6 (IQR 3-9). Abnormal scores for anxiety and depression (≥8/21) were seen in 133 (56.4%) and 72 (30.5%) patients, respectively. Demographic, SC and MSIS-29 data for all participants are presented in Table 1.

Total SC and the "personal relationships" domain were significantly correlated with MSIS-29-PHYS scores (r = −0.09, P = .02 and r = −0.22, P < .001, respectively). The "social support networks" (r = 0.08, P = .95), "civic engagement" (r = −0.07, P = .07), and "trust and cooperative norms" (r = −0.06, P = .11) domains were not significantly correlated with MSIS-29-PHYS scores. Total SC (r = −0.23, P < .001) and all SC domains ("personal relationships": r = −0.29, P < .001; "civic engagement": r = −0.12, P = .01; and "trust and cooperative norms": r = −0.19, P < .001) except for "social support networks" (r = −0.01, P = .39) were significantly correlated with MSIS-29-PSYCH scores. Scatter plots for the correlation between SC and the physical and psychological impact of MS are shown in Figure 1.

The covariates that were associated with the MSIS-29-PHYS scores and were adjusted for in the regression models included age, type of MS, DMTs, disease duration, EDSS, HADS-A, HADS-D, marital status, living arrangements, years living in their current residence and employment status. The MSIS-29-PSYCH scores were adjusted for EDSS, HADS-A, HADS-D and employment status. Covariates included in the most parsimonious model are shown in Table 2. After adjusting for possible confounding variables, the "personal relationships" domain had a significant effect on MSIS-29-PHYS scores (β = −2.70, SE = 1.34; P = .045). Total SC (β = −1.08, SE = 0.33; P = .001) and the "personal relationships" (β = −2.60, SE = 1.20; P = .031) and "trust and cooperative norms" (β = −1.40, SE = 0.61; P = .024) domains had a significant effect on MSIS-29-PSYCH scores (Table 2).

4 | DISCUSSION

The association between SC and improved mental and physical health is well documented in the literature but the exact role of SC in MS is still unclear. Our data showed that higher levels of SC were associated with lower self-rated physical and psychological impact of MS. These results are in line with previous studies highlighting the importance of social factors in shaping health outcomes of pwMS.
Data from cross-sectional studies have shown that social support is positively associated with most dimensions of QOL in pwMS. Indeed, the vital role that social groups play in promoting adaptive coping strategies among pwMS has also been demonstrated. Additionally, some studies have captured the buffering effect of social support on depression, anxiety, pain and other MS symptoms. Although important, social support is just one component of the SC realm. The concept of SC also encompasses other social aspects such as norms of reciprocity and social trust within a community, the levels of participation in social organizations and various forms of civic engagement. A recent systematic review of the literature has highlighted the paucity of research devoted to SC in the field of MS, with the majority of studies aiming to explore aspects of social support but not social participation, trust and reciprocity. Our results demonstrate that exploring other domains of SC yields a more complete comprehension of the relationship between SC and MS. Of particular interest is that both “total SC” and the “trust and cooperative norms” domains had a significant effect on the psychological impact of MS. Thus, reductionist approaches to SC may overlook its impact on pwMS.

In a cross-sectional study involving 172 pwMS, investigators evaluated the association between SC and QOL. In contrast to previous studies exploring the effect of SC on patients with neurological disorders, the authors used a more comprehensive tool...
FIGURE 1  Scatter plots of scores for the physical (blue) and psychological (red) impact of MS by SC domains: (A) personal relationships, (B) social support networks, (C) civic engagement, (D) trust and cooperative norms, and (E) total SC. The shaded area represents the standard deviation. MS, multiple sclerosis; SC, social capital
to measure several SC domains (ie groups and networks; trust and solidarity; collective action and cooperation; information and communication; social cohesion and inclusion, and empowerment and political action). However, it is worth noting that they did not formally control for potentially relevant confounders such as depression, which has been shown to be a major determinant of QOL in pwMS. Their analysis showed that SC and QOL are certainly dependent and might have a positive effect on each other. This is in line with our results that support a role for SC in the psychological well-being of pwMS. Another finding of note in that study was that the “collective action and cooperation” domain of SC was inversely associated with QOL. Similarly, our data showed that the “social support networks” domain of SC tended to correlate negatively with the physical impact of MS but the correlation did not reach statistical significance. Taken together, these findings suggest that some SC domains may also have negative effects on the outcomes of pwMS. Although the exchange of social resources may be beneficial to individuals with respect to health outcomes; it may also exhibit negligible or detrimental effects, provoking feelings of inadequacy or dependence. Indeed, stigmatization during interpersonal interactions and in social relationships can influence the perception of health among pwMS. Further research is needed on the potential downside of SC and its implications for pwMS.

A substantial body of empirical evidence supports the protective effect of SC on physical health. However, our result showed that, after adjusting for confounders, only the “personal relationships” domain but not total SC had a significant effect on the physical impact of MS. This may be explained, at least in part, by the fact that SC may be more salient for physical health in unequal societies than in more egalitarian countries such as Sweden, Canada and the UK. In addition, we cannot rule out the possibility that the impact of total SC on physical health became less significant in the context of unmeasured confounding factors such as smoking, alcohol consumption, physical activity, dietary behaviours and comorbidities.

Our study has some limitations, the most important being that we did not operationalize SC into its many dimensions (ie cognitive; structural; bonding, bridging and linking). The inclusion of each component would have been useful to better elucidate negative and positive associations with health. An additional limitation of our study may lie in the individual nature of our SC measurement. Some authors have highlighted that the novel contribution of SC lies in its collective level; arguing that this approach would better characterize how SC theory extends beyond the conceptually different relationship between social support/ networks and health. Moreover, despite its widespread use in different settings, the ONS SC questionnaire has not been

| TABLE 2 | Multiple linear regression coefficients for SC domains as predictors for MSIS-29-PHYS and MSIS-29-PSYCH |
|-----------------|-----------------|-----------------|-----------------|
| **MSIS-29-PHYS**<sup>a</sup> | **MSIS-29-PSYCH**<sup>b</sup> |
| | Estimate | Standard error | P value | Adjusted R<sup>2</sup> value |
| **Total SC** | −0.68 | 0.367 | .064 | .68 |
| **SC domains** | | | | .68 |
| **Personal relationships** | −2.70 | 1.34 | .045 |
| **Social support networks** | 0.45 | 1.45 | .756 |
| **Civic engagement** | 0.15 | 0.81 | .854 |
| **Trust and cooperative norms** | −0.72 | 0.71 | .307 |
| **Total SC** | −1.08 | 0.33 | .001 | .51 |
| **SC domains** | | | | .51 |
| **Personal relationships** | −2.60 | 1.20 | .031 |
| **Social support networks** | 0.47 | 1.27 | .712 |
| **Civic engagement** | −0.40 | 0.73 | .580 |
| **Trust and cooperative norms** | −1.40 | 0.61 | .024 |

Abbreviations: DMTs, disease-modifying therapies; EDSS, Expanded Disability Status Scale; HADS-A, Hospital Anxiety and Depression Scale-Anxiety; HADS-D, Hospital Anxiety and Depression Scale-Depression; MS, multiple sclerosis; MSIS-29-PHYS, Multiple Sclerosis Impact Scale-29-Physical; MSIS-29-PSYCH, Multiple Sclerosis Impact Scale-29-Psychological; SC, social capital.

<sup>a</sup>Adjusted for age, type of MS, DMTs, disease duration, EDSS, HADS-A, HADS-D, marital status and employment status.

<sup>b</sup>Adjusted for EDSS, HADS-A and HADS-D.
formally evaluated for its psychometric properties in pwMS, which may lead to measurement bias. Another potential bias is that the population we studied is self-selecting, as evidenced by the high proportion of volunteers with a tertiary education (80.5%), compared to a background rate of approximately 40%. Therefore, stronger correlations between SC and the impact of MS may exist if we had studied a more representative population. Finally, this is a cross-sectional study that only allows us to identify associations and causality remains a concern.

In summary, this study showed that higher levels of SC were associated with a lower physical and psychological impact of MS. Although larger studies using longitudinal data and multidimensional approaches are needed to refine the role of SC in MS, our findings can be used as an evidence base to support the development and implementation of SC interventions that aim to promote the health and well-being of pwMS. As a chronic and potentially disabling disease, MS may pose a threat to the social resources of people with the condition, and thus, addressing SC and its impact on the health outcomes of pwMS should be a priority for future research.

ACKNOWLEDGEMENTS
SR is supported by an ECTRIMS (European Committee for Treatment and Research in Multiple Sclerosis) fellowship.

CONFLICT OF INTEREST
SR, SS, KAP and AT have nothing to declare. GG serves as executive editor for Multiple Sclerosis and Related Disorders.

AUTHOR CONTRIBUTIONS
SR and GG conceived and designed the study. SS performed the statistical analysis. SR and GG wrote the first draft of the manuscript. All the authors participated in the interpretation of the results and critical revision of the manuscript.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID
Saúl Reyes https://orcid.org/0000-0002-3230-3263
Sebastian Suárez https://orcid.org/0000-0001-6339-8675
Gavin Giovannoni https://orcid.org/0000-0001-9995-1700

REFERENCES
1. Dobson R, Giovannoni G. Multiple sclerosis - a review. Eur J Neurol. 2019;26(1):27-40.
2. Figved N, Myhr KM, Larsen JP, Aarsland D. Caregiver burden in multiple sclerosis: the impact of neuropsychiatric symptoms. J Neurol Neurosurg Psychiatry. 2007;78(10):1097-1102.
3. Kouzoupis AB, Paparrigopoulos T, Soldatos M, Papadimitriou GN. The family of the multiple sclerosis patient: a psychosocial perspective. Int Rev Psychiatry. 2010;22(1):83-89.
4. Blundell Jones J, Walsh S, Isaac C. The relational impact of multiple sclerosis: an integrative review of the literature using a cognitive analytic framework. J Clin Psychol Med Settings. 2017;24(3-4):316-340.
5. Hakim EA, Bakheit AM, Bryant TN, et al. The social impact of multiple sclerosis-a study of 305 patients and their relatives. Disabil Rehabil. 2000;22(6):288-293.
6. [6] Loneliness report. Multiple Sclerosis Society UK. https://www.mssociety.org.uk/what-we-do/news/loneliness-report. Accessed July 9, 2019.
7. Marmot M, Bell R. Fair society, healthy lives. Public Health. 2012;126:54-510.
8. Calcia MA, Bonsall DR, Bloomfield PS, Selvaraj S, Barichello T, Howes OD. Stress and neuroinflammation: a systematic review of the effects of stress on microglia and the implications for mental illness. Psychopharmacology. 2016;233(9):1637-1650.
9. Johnson RR, Storts R, Welsh TH, Welsh CJR, Meagher MW. Social stress alters the severity of acute Theiler's virus infection. J Neuroimmunol. 2004;148(1-2):74-85.
10. Johnson RR, Prentice TW, Bridgeman P, et al. Social stress alters the severity and onset of the chronic phase of Theiler’s virus infection. J Neuroimmunol. 2006;175(1-2):39-51.
11. Linsenbardt HR, Cook JL, Young EE, et al. Social disruption alters pain and cognition in an animal model of multiple sclerosis. J Neuroimmunol. 2015;288:56-68.
12. Vichaya EG, Young EE, Frazier MA, Cook JL, Welsh CJ, Meagher MW. Social disruption induced priming of CNS inflammatory response to Theiler’s virus is dependent upon stress induced IL-6 release. J Neuroimmunol. 2011;239(1-2):44-52.
13. Young EE, Vichaya EG, Reussner NM, et al. Chronic social stress impairs virus specific adaptive immunity during acute Theiler’s virus infection. J Neuroimmunol. 2013;254(1-2):19-27.
14. Mohr DC, Genain C. Social support as a buffer in the relationship between treatment for depression and T-cell production of interferon gamma in patients with multiple sclerosis. J Psychosom Res. 2004;57(2):155-158.
15. Schwartz C, Frohner R. Contribution of demographic, medical, and social support variables in predicting the mental health dimension of quality of life among people with multiple sclerosis. Health Soc Work. 2005;30(3):203-212.
16. Treadaway K, Cutter G, Salter A, et al. Factors that influence adherence with disease-modifying therapy in MS. J Neurol. 2009;256(4):568-576.
17. Rommer PS, Sühnel A, König N, Zettl UK. Coping with multiple sclerosis-the role of social support. Acta Neurol Scand. 2017;136(1):11-16.
18. Feinstein A. An examination of suicidal intent in patients with multiple sclerosis. Neurology. 2002;59(5):674-678.
19. Reyes S, Giovannoni G, Thomson A. Social capital: implications for neurology. Brain Behav. 2018;9(1):e01169.
20. Cohen-Cline H, Beresford SA, Barrington W, Matsuura R, Wakefield J, Duncan GE. Associations between social capital and depression: a study of adult twins. Heal Place. 2018;50:162-167.
21. Jones R, Heim D, Hunter S, Ellaway A. The relative influence of neighbourhood incivilities, cognitive social capital, club membership and individual characteristics on positive mental health. Health Place. 2014;28:187-193.
22. Rimaz S, Mohammad K, Dastoorpoor M, Jamshidi E, Majzadeh R. Investigation of relationship between social capital and quality of life in multiple sclerosis patients. Glob J Health Sci. 2014;6(6):261-272.
23. Koutsogeorgou E, Chiesi AM, Leonardi M. Social capital components and social support of persons with multiple sclerosis: a systematic review of the literature from 2000 to 2018. Disabil Rehabil. 2019:1-13. https://doi.org/10.1080/09638288.2019.1597182. [Epub ahead of print].
24. Polman CH, Reingold SC, Banwell B, et al. Diagnostic criteria for multiple sclerosis: 2010 Revisions to the McDonald criteria. Ann Neurol. 2011;69(2):292-302.
25. Office for National Statistics. Social Capital in the UK: May 2017. https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/bulletins/socialcapitalintheuk/may2017. Accessed September 2, 2019.
26. Mcguigan C, Hutchinson M. The multiple sclerosis impact scale (MSIS-29) is a reliable and sensitive measure. J Neurol Neurosurg Psychiatry. 2004;75(2):266-269.
27. Kurtzke JF. Rating neurologic impairment in multiple sclerosis: an expanded disability status scale (EDSS). Neurology. 1983;33(11):1444-1452.
28. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361-370.
29. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the hospital anxiety and depression scale: an updated literature review. J Psychosom Res. 2002;52(2):69-77.
30. Honarmand K, Feinstein A. Validation of the Hospital Anxiety and Depression Scale for use with multiple sclerosis patients. Mult Scler J. 2009;15(12):1518-1524.
31. The Ministry of Housing Communities and Local Government. English indices of deprivation. http://imd-by-postcode.opendatacommunities.org/. 2015. Accessed November 26, 2018.
32. Smith T, Noble M, Noble S, Wright G, Mclennan D, Plunkett E. The English Indices of Deprivation 2015. London, UK: Department of Communities and Local Government; 2015. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/464485/English_Indices_of_Deprivation_2015_-_Technical-Report.pdf.
33. Kim D, Subramanian SV, Kawachi I. Social capital and physical health. In: Kawachi I, Subramanian SV, Kim D, eds. Social Capital and Public Health. New York, NY: Springer; 2008:139-190.
34. Ehsan AM, De Silva MJ. Social capital and common mental disorder: a systematic review. J Epidemiol Community Health. 2015;69(10):1021-1028.
35. Costa DC, Sá MJ, Calheiros JM. Social support network and quality of life in multiple sclerosis patients. Arq Neuropsiquiatr. 2017;75(5):267-271.
36. Tabuteau-Harrison SL, Haslam C, Mewe AJ. Adjusting to living with multiple sclerosis: The role of social groups. Neuropsychol Rehabil. 2016;26(1):36-59.
37. Osborne TL, Jensen MP, Ehde DM, Hanley MA, Kraft G. Psychosocial factors associated with pain intensity, pain-related interference, and psychological functioning in persons with multiple sclerosis and pain. Pain. 2007;127(1):52-62.
38. Henry A, Tourbah A, Camus G, et al. Anxiety and depression in patients with multiple sclerosis: the mediating effects of perceived social support. Mult Scler Relat Disord. 2019;27:46-51.
39. Villalonga-Olives E, Kawachi I. The measurement of social capital. Gac Sanit. 2015;29(1):62-64.
40. Amato MP, Ponziani G, Rossi F, Liedl CL, Stefanile C, Rossi L. Quality of life in multiple sclerosis: the impact of depression, fatigue and disability. Mult Scler J. 2001;7(5):340-344.
41. Perry BL, Pescosolido BA. Social network activation: the role of health discussion partners in recovery from mental illness. Soc Sci Med. 2015;125:116-128.
42. Grytten N, Måseide P. ‘When I am together with them I feel more ill’. The stigma of multiple sclerosis experienced in social relationships. Chronic Illn. 2006;2(3):195-208.
43. Cook JE, Germano AL, Stadler G. An exploratory investigation of social stigma and concealment in patients with multiple sclerosis. Int J MS Care. 2016;18(2):78-84.
44. Islam MK, Merlo J, Kawachi I, Lindström M, Gerdtham UG. Social capital and health: does egalitarianism matter? A literature review. Int J Equity Health. 2006;5:3.
45. Bertotti M, Watts P, Netuveli G, et al. Types of social capital and mental disorder in deprived urban areas: A multilevel study of 40 disadvantaged London neighbourhoods. PLoS ONE. 2013;8(12):e80127.
46. Organisation for Economic Co-operation and Development (OECD). OECD Guidelines on Measuring Subjective Well-Being. Paris: OECD Publishing; 2013.
47. Harper R, Kelly M. Measuring social capital in the United Kingdom. London, UK: Office for National Statistics; 2003.
48. Organisation for Economic Co-operation and Development (OECD). Population with Tertiary Education (Indicator); 2018. https://data.oecd.org/eduattpopulation-with-tertiary-education.htm. Accessed September 3, 2019.

How to cite this article: Reyes S, Suarez S, Allen-Philbey K, Thomson A, Giovannoni G. The impact of social capital on patients with multiple sclerosis. Acta Neurol Scand. 2020;142:58–65. https://doi.org/10.1111/ane.13244