Physical multimorbidity, depressive symptoms, and social participation in adults over 50 years of age: findings from the English Longitudinal Study of Ageing

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ABSTRACT

Objectives: The aim of the current study was to identify specific patterns of physical multimorbidity and examine how these patterns associated with changes in social participation over time.

Methods: We used latent class analysis to identify clusters of physical multimorbidity in 11,391 older adults. Mixed effects regression models were used to assess associations between physical multimorbidity clusters and changes in social participation over 15 years.

Results: Four clusters of physical multimorbidity were identified. All physical multimorbidity clusters were associated with reductions in cultural engagement (e.g., visits to theatre, cinema, museums) over time, with the strongest association seen in the complex/multisystem cluster (β = −0.26, 95% CI = −0.38 to −0.15). Similar results emerged for leisure activities. Adjusting for depressive symptoms further attenuated some associations. All physical multimorbidity clusters were associated with an increase in civic participation over time.

Conclusions: Physical multimorbidity reduced some aspects of social participation over time, with specific combinations of conditions having increased risk of reductions.

Introduction

The prevalence of multimorbidity – the coexistence of two or more chronic conditions – is estimated to reach 67.8% of the UK population over 65 years by 2035 (Kingston et al., 2018). Associations between multimorbidity and important health-related outcomes such as physical functional decline (Storeng et al., 2020), health-related quality of life (Makovski et al., 2019), poor future health status (Koroukian et al., 2015), and mortality (Willadsen et al., 2018) have been well described. However, to date, very little is known about the impact of multimorbidity on social participation, a key patient-related outcome identified by the James Lind Alliance in their recent exercise relating to multiple conditions in older populations (Parker et al., 2019).

Social participation, such as engagement with culture and the arts, involvement in civic society, and participation in leisure activities, exerts positive influences on health. On a general level, social participation is associated with better health outcomes and reduced mortality (Bennett, 2002). More specifically, cultural engagement (i.e., going to the theatre, museums, galleries, and live music shows) is associated with lower incident depression (Fancourt & Tymoszuk, 2019), lower functional decline (Rogers & Fancourt, 2020), lower cognitive decline (Fancourt & Steptoe, 2018), and lower disease-specific (Bygren et al., 2009) as well as all-cause mortality (Fancourt & Steptoe, 2019).

Civic participation comprises a wide range of pursuits and can include volunteering as well as participating in group and community activities. Volunteering is associated with better mental health (Musick & Wilson, 2003), lower risk of cognitive impairment (Infurna et al., 2016), lower risk of cardiovascular disease (Burr et al., 2016), and lower risk of mortality (Jenkinson et al., 2013). Being involved in community groups is associated with better recall of health messages potentially leading to improved health outcomes (Viswanath et al., 2006). Involvement in local politics is associated with lower mortality rates (Sundquist et al., 2014). Evidence suggests that engaging in leisure activities also exerts positive health effects. Definitions of leisure activities range widely but generally include activities that people engage in during their spare time, such as gardening, art, or education classes. Leisure activities are associated with better physical function (Sala et al., 2019), better cognitive function (Dregan & Gulliford, 2013), and lower risk of mortality (Agahi & Parker, 2008).

The evidence suggests that engagement in cultural, civic, and leisure activities provides a protective buffer against poor health outcomes. However, it is likely that associations...
between social participation and health are bidirectional and to date few studies have examined the impact that long-term conditions might have on these potentially-health protective behaviours. Increasing age and poor health status are associated with a decrease in participation in cultural activities (Reeves, 2014). Poor self-rated health and the receipt of physical diagnoses negatively impact leisure activity in older people (Paggi et al., 2016). Regarding multimorbidity, there are cross-sectional differences between older people with and without multimorbidity in terms of social participation (Ma et al., 2021), and engagement in social leisure and cultural activities (Galenkamp et al., 2016). However, to date, no one has examined longitudinal associations between multimorbidity and cultural, civic, and leisure activities. These outcomes are health-protective but are also impacted by health. Therefore, it is important to understand the extent to which multimorbidity associates with these outcomes as this will have clear consequences for disease progression and mortality. Moreover, understanding the impact of specific clusters of multimorbidity on future participation in these social aspects of life may identify health conditions associated with the greatest decline in social participation in people with multimorbidity. This evidence is critical to inform future mechanistic investigations. It also has the potential to identify groups of people with multimorbidity that are at lower or higher risk of reduced social participation.

In the current study, we used latent class analysis to identify specific patterns of physical multimorbidity within a representative sample of the older English population. We then examined which patterns of physical multimorbidity associated with changes in different facets of social participation over 15 years of follow-up. Since physical multimorbidity is prospectively associated with depression (Ronaldson et al., 2021), and as depression reduces social participation (Wilkie et al., 2016), we also assessed the extent to which depressive symptoms affected associations between physical multimorbidity and social participation.

Method

Study population

The data came from the English Longitudinal Study of Ageing (ELSA); an ongoing nationally representative study of community-dwelling English adults aged ≥50 years (n = 15,981). Data collection began in 2002–2003 (Wave 1) and participants were recruited from households that were included in the Health Survey for England. A sample of 11,391 core members participated at Wave 1, with follow-up data collection waves occurring every 2 years. To ensure participants aged 50–53 were represented at Wave 1, with follow-up data collection waves occurring every 2 years. To ensure participants aged 50–53 were represented throughout data collection, refreshment samples were added to subsequent data collection waves. The flow of participants through each wave of data collection has been detailed extensively (Steptoe et al., 2013). The current study used data from Waves 1 to 8 covering 15 years of follow-up. Patterns of physical multimorbidity at Wave 1 were determined using all core members (n = 11,391). Longitudinal associations between physical multimorbidity and social participation were examined in participants who provided data for the relevant outcome in at least three waves.

Ethical approval was obtained from the English National Health Service (NHS) Research Ethics Committee under the National Research and Ethics Service and participants gave full informed consent to take part in the study.

Physical multimorbidity

Fourteen chronic physical conditions were measured at each wave based on self-report of a doctor diagnosis. The conditions selected for inclusion in the physical multimorbidity measure in the current study were informed by a previous ELSA publication on physical multimorbidity (Poole & Steptoe, 2018) as well as consistency of measurement of these conditions at each ELSA wave. Physical conditions included hypertension, coronary heart disease (CHD; comprising myocardial infarction and/or angina), other cardiac illnesses (heart failure, arrhythmia, heart murmur), stroke, diabetes, lung disease (e.g. chronic bronchitis and emphysema), asthma, arthritis, osteoporosis, cancer, Parkinson’s disease, dementia, glaucoma, and cataracts.

Depressive symptoms

Depressive symptoms were measured at Wave 1 using the eight-item Center for Epidemiological Studies Depression Scale (CES-D). The CES-D is a screening tool widely used to identify people with depressive symptoms (Radloff, 1977). The psychometric properties of the eight-item CES-D have been shown to be comparable to the original 20-item version (Fisher et al., 2005). An eight-item CES-D summary score was derived by summing responses to the eight dichotomous questions leading to a possible range of 0–8. A cut-off score of ≥4 was used to identify those with elevated depressive symptoms as this corresponds to the cut-off of ≥16 on the 20-item CES-D (Demakakos et al., 2014).

Cultural engagement

Cultural engagement was measured using self-report items assessing frequency of visits to (a) the theatre, concerts, or opera, (b) the cinema, and (c) museums at each data collection wave. For example, participants were asked “How often, if at all, do you visit an art gallery or museum?”. Responses were recorded on a six-point scale (ranging from 1 to 6) coded as never, less than once a year, once or twice a year, every few months, about once a month, or twice a month or more. We combined responses from these three variables to create an overall cultural engagement frequency score (Fancourt & Tymoszuk, 2019). Summed totals ranged from 3 to 18, with higher scores indicating higher cultural engagement. Cultural engagement was assessed at each of the follow-up waves (Wave 2 to Wave 8) to enable us to examine how baseline multimorbidity clusters were associated with variability in this outcome measure over time. It should be noted that cultural engagement in the current study was not a measure of participation in activities pertaining to particular ethnic minority groups.

Civic participation

Civic participation was measured using a self-report item assessing whether or not a participant was a member of any of the following organisations, clubs, or societies: (a) political party, trade union, or environmental groups, (b) tenants’ groups, resident groups, neighbourhood watch, (c) church or other religious groups, and (d) charitable associations. Responses were coded
Leisure activities were measured using a self-report item assessing whether or not a participant was a member of any of the following organisations or clubs, or societies: (a) education, art or music groups or evening classes, (b) social club, (c) sports clubs, gym, exercise classes, (d) any other organisations, club, or societies. Responses were coded in a binary format: yes/no. We combined responses from the four variables to create an overall count of leisure activities. Summed totals ranged from 0 to 4. Leisure activities were measured at each of the follow-up data waves to enable more complex models of change over time in this indicator.

Covariates

Several covariates known to be related to physical multimorbidity, the study outcomes, or both were included at each wave of data collection (Ashworth et al., 2019; Galenkamp et al., 2016; Hand & Howrey, 2019; Kristensen et al., 2019; Lee et al., 2008; Sakamoto et al., 2017). Sociodemographic variables included age (continuous variable), sex, ethnicity (White or ethnic minority groups as the ELSA cohort is predominantly White British), and whether participants were married/cohabiting with a partner. Socioeconomic status (SES) was included as quintiles of net non-pension wealth, which refers to the gross financial wealth of each participant with financial debt subtracted, educational attainment which was divided into three categories (no qualifications/O Level or equivalent, A Level/higher education below degree, degree or equivalent), and employment status (employed or retired/unemployed). Current smoking status was included as a binary variable (yes/no) and we included a measure of social network size. This was calculated by summing responses from three questions asking participants about the number of children/friends/other immediate family (e.g., cousins) they thought they had a close relationship with. As per previous protocols we limited the number of relationships given for each question to 10 resulting in a social network size score ranging from 0 to 30 for each wave (Rafnsson et al., 2015).

Mobility was assessed with a single item that asked participants whether they had any difficulty walking ¼ mile unaided. Responses were recorded on a four-point scale that ranged from 1 “Unable to do this” to 4 “No difficulty doing this.” Cognitive function at each wave was measured by aggregating performance on five objective tasks administered in face-to-face interviews. These were immediate and delayed recall, verbal fluency, and speed and accuracy on a letter cancellation task. In accordance with previous protocols, we Z transformed scores on the five tasks and averaged these to generate an index of cognitive function (Poole & Steptoe, 2018). All five tasks were performed from Wave 1 through Wave 5. However, the verbal fluency task was not performed at Wave 6, and the letter cancellation task was not performed at Wave 6, 7, or 8. Where certain tasks were omitted, the index of cognitive function was generated from the available tasks.

We modelled all study covariates (including mobility and cognitive function) as fixed effects as we were interested in their average effect on the association between multimorbidity and social participation.

Statistical analysis

We used latent class analysis to explore multimorbidity patterns from the 14 physical conditions measured in all participants who provided data at Wave 1. The optimal number of classes was determined based on the lowest Akaike Information Criterion (AIC) and Bayesian-Schwarz Information Criterion (BIC), and clinical interpretability (Akaite, 1974; Nylund et al., 2007). In the current study, once the number of latent classes had been identified, each individual in the sample was assigned to a class for which they had the largest posterior probability (i.e., the class they most belonged to). We described the characteristics of the overall sample and the classes identified at Wave 1 using means and standard deviations, medians and interquartile ranges, and frequencies in Table 1.

In order to examine associations between physical multimorbidity classes and subsequent changes in cultural engagement over the eight waves of data collection, linear mixed models were performed. For civic participation and leisure activities (both count variables), mixed effects ordinal logistic regression models were used. These analyses enabled us to examine average change in study outcomes measures over the study period related to baseline clusters of multimorbidity. Analyses were carried out in all participants who provided data for the relevant outcome in at least three waves. For all outcomes Model 1 was unadjusted and included only the physical multimorbidity classes. Model 2 was adjusted by age and sex, with age also included as a time-varying variable. Model 3 (fully adjusted) was additionally adjusted by ethnicity, couple status, net non-pension wealth, educational attainment, employment status, smoking, social network size, mobility, and cognitive function. We then included depressive symptoms (continuous eight-item CES-D scores) at each wave as an additional covariate (Model 4: fully adjusted + depressive symptoms) to examine the extent to which it attenuated associations between physical multimorbidity classes and social participation outcomes. The best-fit model was selected by considering BIC values.

Data were missing for several variables at each wave of data collection: ethnicity (0.02–0.67%), smoking (0.05–1.76%), net non-pension wealth (1.36–2.87%), educational attainment (0.01–2.40%), cognitive function (4.59–16.88%), mobility (0.02–1.55%), depressive symptoms (2.52–5.61%), cultural engagement (1.53–29.84%), civic participation (13.35–19.87%), and leisure activities (13.35–19.87%). As multivariable normality could not be assumed, multiple imputation using chained equations with 10 imputations was performed to deal with missing data (Azur et al., 2011). Multiple imputation included outcome and exposure variables as well as all covariates in order to account for complex interrelationships between all study variables. All analyses were performed using imputed data and conducted in STATA 15.1 (Stata Corp LLP, College Station, TX).

Sensitivity analysis

Planned sensitivity analyses were carried out to validate the study findings. We examined differences in the outcome variables and covariates between those from Wave 1 of data collection (n = 11,391) who provided at least three waves of
Results

Multimorbidity patterns: Latent class analysis

A total of 11,391 participants completed Wave 1 of ELSA data collection and comprised the analytical sample. We used latent class analysis to identify multimorbidity clusters at Wave 1, with AIC and BIC values supporting a four-class model (see Supplementary Table S1). Based on probabilities of class membership, four clusters of multimorbidity were identified: (a) a relatively healthy class with the lowest prevalence in most diseases (n = 7748, 68.0%), (b) a hypertension/diabetes cluster (n = 1758, 15.4%), (c) a respiratory cluster (n = 1201, 10.5%), and (d) a complex/multisystem cluster (n = 684, 6.0%). Probabilities of class membership for each latent class are provided in Supplementary Table S2. These class labels represent the long-term conditions that were most prevalent in each class. As hypertension, arthritis, and cataracts were prevalent in all classes apart from the relatively healthy class (indicating the ubiquity of these conditions in older age), these conditions were mostly omitted from the class labels. Figure 1 illustrates the four classes identified in the current study with whole population prevalence for each condition. Participants in each class might also have had other conditions which were not highly prevalent in the identified pattern.

Sample characteristics

Sample characteristics for the overall sample and for each multimorbidity class are provided in Table 1. The median age of the overall sample was 64 years (IQR = 56–73), 54.5% (n = 6205) were female, 2.8% (n = 320) were from ethnic minority groups, and most participants were married or cohabiting (68.7%, n = 7830). The average number of physical conditions in the overall sample was 64 years (IQR = 56–73), 54.5% (n = 6205) were female, 2.8% (n = 320) were from ethnic minority groups, and most participants were married or cohabiting (68.7%, n = 7830). The average number of physical conditions in the overall sample was 64 years (IQR = 56–73), 54.5% (n = 6205) were female, 2.8% (n = 320) were from ethnic minority groups, and most participants were married or cohabiting (68.7%, n = 7830).
all other classes. The highest proportion of individuals from ethnic minority groups was in the hypertension/diabetes class. Individuals in all multimorbidity classes were less likely to be married or cohabiting compared to the relatively healthy class, were less likely to be in employment, and were less likely to have a university degree or equivalent. The complex/multisystem and respiratory classes had the highest proportion of people in the poorest wealth quintile. Smoking rates were highest in the respiratory class and self-rated mobility was lowest in the complex/multisystem class. Total disease counts were highest in the complex/multisystem class, followed by the respiratory and hypertension/diabetes classes, and the majority (78.5%) of individuals in the complex/multisystem classes had four or more long-term conditions. Depressive symptoms were higher in all physical multimorbidity classes compared to the relatively healthy class and were highest in participants in the complex/multisystem class.

**Linear mixed models: Cultural engagement**

We used linear mixed models to look at associations between multimorbidity patterns and subsequent changes in cultural engagement in participants who provided cultural engagement data in at least three waves. Means and standard deviations for each wave are provided in Table 2. Associations between multimorbidity patterns and cultural engagement over time are provided in Table 3. In Model 2, 3, and 4 age was also included as a time-varying variable. BIC values indicate that Model 4 (fully adjusted + depressive symptoms) best fitted the data.

In the fully adjusted model (Model 3), we found that participants in all multimorbidity classes differed significantly from the relatively healthy class in terms of cultural engagement over time. The strength of association differed, however, with the complex/multisystem class having the strongest negative association with cultural engagement over time ($\beta = -0.26, 95\% CI = -0.38$ to $-0.15$), followed by the respiratory class ($\beta = -0.13, 95\% CI = -0.21$ to $-0.05$), and the hypertension/diabetes class ($\beta = -0.08, 95\% CI = -0.14$ to $-0.01$). The addition of depressive symptoms as a covariate (Model 4) fully attenuated associations between the hypertension/diabetes class and cultural engagement over time ($p = 0.076$) and weakened the strength of associations for both the respiratory ($\beta = -0.09, 95\% CI = -0.17$ to $-0.01$) and the complex/multisystem ($\beta = -0.23, 95\% CI = -0.34$ to $-0.12$) classes.
Table 3. Associations between multimorbidity patterns at Wave 1 and cultural engagement, civic participation, and leisure activities over all waves.

| Multimorbidity pattern | Model 1 (unadjusted) | Model 2 (age and sex) | Model 3 (fully adjusted) | Model 4 (fully adjusted + depressive symptoms) |
|------------------------|-----------------------|-----------------------|--------------------------|-----------------------------------------------|
|                        | BIC: 333980.7         | BIC: 330752.9         | BIC: 306550.2            | BIC: 295223.7                                 |
| Relatively healthy     | Ref                   | Ref                   | Ref                      | Ref                                           |
| Hypertension/diabetes  | −1.22 (−1.31 to −1.15)| −0.60 (−0.68 to −0.52)| −0.08 (−0.14 to −0.01)  | −0.06 (−0.13 to −0.01)                       |
|                        | <0.001                | <0.001                | 0.023                    | 0.076                                         |
| Respiratory            | −1.36 (−1.45 to −1.27)| −0.81 (−0.90 to −0.71)| −0.13 (−0.21 to −0.05)  | −0.09 (−0.17 to −0.01)                       |
|                        | <0.001                | <0.001                | 0.001                    | 0.025                                         |
| Complex/multisystem    | −1.94 (−2.07 to −1.81)| −1.27 (−1.40 to −1.14)| −0.26 (−0.38 to −0.15)  | −0.23 (−0.34 to −0.12)                       |
|                        | <0.001                | <0.001                | <0.001                   | <0.001                                        |

Notes. Model 1: Unadjusted.
Model 2: Age and sex adjusted.
Model 3: Model 2 + ethnicity, couple status, wealth, education level, employment, smoking, social network size, mobility, cognitive function.
Model 4: Model 3 + depressive symptoms (continuous CES-D score).
Mixed effects ordinal logistic regression models: Civic participation and leisure activities

We used mixed effects ordinal logistic regression models to examine associations between physical multimorbidity patterns and subsequent changes in civic participation and leisure activities in participants who provided data for these outcomes in at least three waves. Means and standard deviations for each wave are provided in Table 2. Associations between physical multimorbidity patterns and both civic participation and leisure activities over time are provided in Table 3.

For civic participation, BIC values indicate that Model 4 (fully adjusted + depressive symptoms) best fitted the data. In this model, we found that all multimorbidity classes differed significantly from the relatively healthy class in terms of civic participation in that those in the hypertension/diabetes (adjusted odds ratio (aOR) = 1.14, 95% CI = 1.09 to 1.21), the respiratory (aOR = 1.18, 95% CI = 1.11 to 1.25), and the complex/multisystem (aOR = 1.14, 95% CI = 1.04 to 1.25) classes were more likely to engage in civic participation compared to the relatively healthy class.

For leisure activities, BIC values indicated that Model 4 (fully adjusted + depressive symptoms) best fitted the data. In the fully adjusted model (Model 3) we found that all multimorbidity classes differed significantly from the relatively healthy class in that they were less likely to take part in leisure activities over time. However, when depressive symptoms were added as a covariate (Model 4), those in the hypertension/diabetes class (aOR = 0.94, 95% CI = 0.89 to 0.99) and the cardiorespiratory class (aOR = 0.86, 95% CI = 0.78 to 0.94) remained less likely than those in the relatively healthy class to take part in leisure activities, but the difference between the respiratory class and the relatively healthy class became insignificant (p = 0.152).

Sensitivity analysis

Comparisons between those who had outcome data on at least three waves of data collection and those who did not show that the sample included in the mixed regression models differed significantly from the remainder. Results are presented in Supplementary Material: Table S3. Those included in the mixed regression models were younger, less likely to be from an ethnic minority group, and had a lower proportion of people in the poorer wealth quintiles. They were also less likely to be current smokers, had better mobility and cognitive function, and were less likely to have depressive symptoms. The sample included in the mixed regression models had higher levels of cultural engagement, civic participation, and leisure activities, and had lower levels of physical multimorbidity. They also differed in multimorbidity class membership with more participants in the relatively healthy class.

Results from fully adjusted mixed effects logistic regressions examining associations between multimorbidity class and separate facets of civic participation are presented in Table S4 (Supplementary Material). We found that those in the respiratory (aOR = 1.31, 95% CI = 1.17 to 1.47) and complex/multisystem (aOR = 1.31, 95% CI = 1.11 to 1.54) classes were more likely than those in the relatively healthy class to be members of a political party, trade union, or environmental group. Participants in the hypertension/diabetes class (aOR = 1.15, 95% CI = 1.06 to 1.24) and the respiratory class (aOR = 1.16, 95% CI = 1.06 to 1.27) were more likely to be a member of a tenants’ group, resident group, or neighbourhood watch. All multimorbidity classes were more likely than the respiratory class to have members in the church or other religious groups. None of the multimorbidity classes differed from the relatively healthy class in terms of involvement in charitable groups (apart from a borderline association observed in the respiratory class, p = 0.047).

Discussion

In a representative sample of the older English population, we identified four clusters of physical multimorbidity: a relatively healthy cluster, a hypertension/diabetes cluster, a respiratory cluster, and a complex/multisystem cluster. Apart from the relatively healthy cluster, all clusters also included high levels of hypertension, arthritis, and cataracts all known to be ubiquitous in older age (Jaul & Barron, 2017). We then looked at how these physical multimorbidity classes associated with changes in three aspects of social participation over time: cultural engagement, civic participation, and leisure activities. Moreover, we examined the extent to which symptoms of depression affected the strength of these associations. To the best of our knowledge, this is the first study to look at associations between multiple physical long-term conditions and social participation over time. The use of a data-driven approach to define physical multimorbidity clusters, and the consideration of depressive symptoms, are also novel aspects of the study.

Our findings revealed that when compared to the relatively healthy cluster, all physical multimorbidity clusters were associated with a decline in cultural engagement over time. This reduction was most pronounced within the complex/multisystem cluster. The association between the hypertension/diabetes cluster and cultural engagement was attenuated by the inclusion of depressive symptoms. Also, the strength of the associations for the respiratory and complex/multisystem clusters with cultural engagement were reduced by the presence of depressive symptoms. In terms of leisure activities, all physical multimorbidity clusters were associated with a reduction in this outcome when compared to the relatively healthy cluster, with the complex/multisystem cluster showing the strongest reduction. The addition of depressive symptoms to the model fully attenuated this association for the respiratory cluster. Finally, physical multimorbidity clusters were associated with increased civic participation over time, with no evidence for a modulating role of depressive symptoms.

The reductions seen in cultural engagement and leisure activities in those with physical multimorbidity in the current study are in agreement with previous research that has reported cross-sectional reductions in similar outcomes in people with poor physical health status, poor self-rated health, as well as multimorbidity (Galenkamp et al., 2016; Ma et al., 2021; Paggi et al., 2016; Reeves, 2014). The current study builds on this body of research, showing that there are longitudinal associations between physical multimorbidity and social participation. Moreover, this study provides a more in-depth examination of how specific clusters of coexisting physical conditions and depressive symptoms affect social participation. There are several plausible pathways through which physical multimorbidity might diminish social participation, including changes in physical mobility (Vancampfort et al., 2017) and cognitive functioning (Caracciolo et al., 2013). Our analyses accounted for these factors, pointing towards alternative pathways. For example,
illness severity and associated pain likely contributes to poor social participation (Zimmer et al., 1997). Although we had no direct measures of illness severity or pain in the current study, we found that being in the complex/multisystem cluster had the greatest reduction in cultural engagement and leisure activities. Patients in this cluster had the highest number of physical conditions suggesting that these changes in social participation are most pronounced in patients with the most burdensome multimorbidity. Impaired functional status (Stoeng et al., 2020) and frailty (Vetrano et al., 2019) are other plausible pathways through which social participation could be affected in those with multiple long-term conditions.

The psychological effects of multimorbid physical conditions are likely to adversely impact social participation. Depression is prospectively associated with physical multimorbidity (Ronaldson et al., 2021), and in the current study, depressive symptoms were higher in all multimorbidity clusters compared to the relatively healthy cluster. Likewise, depression reduces social participation (Wilkie et al., 2016). Depressive symptoms partially affected the observed associations between multimorbidity clusters and social participation. Addition of depressive symptoms fully attenuated the association between the hypertension/diabetes cluster and cultural engagement. What this suggests is that symptoms of depression likely mediate this association; in other words, the physical symptoms associated with coexisting hypertension and diabetes are less important relative to psychological burden when it comes to engaging with cultural activities. Adjustment for depressive symptoms also fully attenuated the association between the respiratory class and leisure activities suggesting a mediating effect. Of note, the respiratory cluster included more women which might indicate that depressive symptoms are more important than physical factors for women with respiratory multimorbidity when it comes to leisure activities involvement. Future research should seek to assess the mediating effect of depressive symptoms in patients with these conditions and delineate the pathways linking clusters of physical multimorbidity with reductions in social participation. In contrast, being in any physical multimorbidity group was associated with an increase in civic participation over time, compared to the relatively healthy group. Previous research has shown that poor health leads to a decrease in civic participation (e.g., membership in community organisations, volunteering, secular activism through the church) (Nelson et al., 2019). Therefore, it is somewhat surprising that poorer physical health was associated with increased civic participation over time in the current study, even after adjusting for depressive symptoms. When we looked at the individual facets of civic participation in the current study, we found that all multimorbidity classes were more likely to be members of a church or other religious group compared to the relatively healthy group. Religious activity has been found to be higher in older adults with multimorbidity (Sowa et al., 2016) perhaps serving as an adaptation to the difficulties that come with multiple long-term conditions. We found that those with complex/multisystem and respiratory multimorbidity were more likely than the relatively healthy to be politically active. It is plausible that those with complex physical multimorbidity might become more involved in political life over issues such as access to healthcare. It has been previously reported that certain types of diseases, such as cancer and respiratory conditions, lead to increases in civic participation (Sund et al., 2017). The association between multimorbidity and increased civic participation did not appear to be driven by involvement in charitable associations.

**Practical implications**

The current study findings emphasise that healthcare providers (particularly those in gerontological practice) should be mindful of how specific clusters of physical multimorbidity could adversely affect social participation (i.e., cultural and leisure activities), depriving these patients of a key resource for well-being, and in turn accelerating complex multimorbidity accumulation (Dekhtyar et al., 2019). Furthermore, routine assessments for depression in those with physical multimorbidity, particularly those with hypertension/diabetes and clusters of respiratory conditions, may help to preserve social participation in these patients. Social prescribing enables healthcare professionals to refer people to a range of local, non-clinical services to support their health and wellbeing. There is evidence that social prescribing schemes, which include improving access to the arts, books, and other leisure activities, are successful in improving the wellbeing of patients with mental and physical health issues (Chatterjee et al., 2018). Social prescribing should be routinely considered for patients with physical multimorbidity, particularly those with clusters of respiratory and cardiometabolic diseases. Although social prescribing has its roots in the English health system, there is evidence it is now being adopted in other countries (Alderwick et al., 2018; Nowak & Mulligan, 2021).

**Strengths and limitations**

This is among the first studies assessing prospective associations between specific clusters of physical multimorbidity and social participation. One of the main strengths of the study is the use of a data-driven approach to define physical multimorbidity, rather than understanding multimorbidity in terms of quantity. This approach provided a more in-depth account of disease clusters, with clear health and policy implications. This study also highlighted the importance of assessing different aspects of social participation separately seeing as civic participation seems to be differentially affected by physical multimorbidity compared to participation in cultural and leisure activities. Additional strengths include the use of a relatively large sample from a nationally representative dataset and a long-term follow-up period (15 years).

Several limitations need to be considered. One particular concern when looking at factors such as cultural engagement or civic participation is that there is a strong social gradient associated with these outcomes (Reeves & de Vries, 2016). There is also a strong social gradient evident in physical multimorbidity (Schütz et al., 2017). What this suggests is that links between physical multimorbidity and social participation might be explained by SES. However, in the current study, a significant association between physical multimorbidity with different measures of social participation emerged even after adjusting for several SES indicators (e.g. non-pension wealth, educational attainment, and employment status). In the current study, we considered social network size to be a covariate rather than a social participation outcome. The main reason being that social networks are assessed in terms of number of family or friends people have contact with, while social participation is assessed as involvement in social groups/organisations – a more active construct. Furthermore, our analyses did not model social network as a moderator of the association between multimorbidity and social participation, as we aimed to examine the
Social prescribing in the US and England: Emerging interventions to reverse causality and residual confounding. While the study analyses adjusted for a number of relevant confounders, we cannot exclude the possibility of unmeasured confounding. For example, we did not control for disease severity and associated pain known to impact social participation (Zimmer et al., 1997). Moreover, we were unable to consider the urban-rural divide, known to impact both social participation and health (Vogelsang, 2016). Finally, while the analyses relied on a nationally representative sample of older English adults, the generalisability of the findings to other populations (e.g., younger people or people living in diverse contexts) is questionable. There are known ethnic differences in social participation (Lindström, 2005). As ELSA is largely a White British cohort, caution should be exercised when generalising results to other ethnic groups. Recent studies have also indicated that people with physical multimorbidity from Low and Middle Income Countries (LMIC) show lower rates of social participation possibly due to reduced availability of personal and contextual resources (Ma et al., 2021). Thus, our study evidence might not necessarily generalise to LMIC and future cross-sectional studies are warranted to identify factors that might explain differences in social participation between countries. Moreover, the sample included in mixed regression models in the current study differed significantly on sociodemographic, behavioural, and clinical factors when compared to those not included, as well as having higher levels of social participation overall. Although this introduces potential bias, the direction is likely towards an underestimation of the true impact of multimorbidity on social participation. This suggestion is based on the lower rates of social participation and the higher rates of multimorbidity seen in the excluded participants. Nevertheless, the study findings are in line with evidence (albeit on different outcomes) from the Health and Retirement Study in the US (van Zon et al., 2020).

Conclusion
Individuals with physical multimorbidity differed from those who were relatively healthy in all facets of social participation, with the strength of these associations varying for particular disease clusters. Inclusion of depressive symptoms in statistical models attenuated these associations in some cases, and future studies are needed to explore a potential modulatory role for depression. Overall, older individuals with multiple chronic physical conditions, and specific combinations of conditions, appeared to experience a decline in cultural engagement and leisure activities over time, relative to healthier adults. The reverse association was observed with regards to civic participation, although this needs further confirmation. Social participation is an important patient-reported outcome measure, and our study findings support the value of including social participation is a potential indicator of healthy ageing within multimorbidity.

Disclosure statement
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