# Cultural engagement and prevalence of pain in socially isolated older people: a longitudinal modified treatment policy approach

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## Summary

**Background** It remains uncertain whether cultural engagement positively influences the reduction of pain risk, particularly depending on the social isolation status. The aim of this study was to examine the impact of cultural engagement on the reduction of pain prevalence over a 6-year follow-up period among older people, particularly those experiencing different dimensions of social isolation.

**Methods** This study was a prospective longitudinal study. We analysed the English Longitudinal Study of Ageing cohort, consisting of 6468 community-dwelling adults aged ≥50 years old who provided data in waves 6 (2012–2013), 7 (2014–2015), 8 (2016–2017), and 9 (2018–2019). Self-reported cultural engagement (going to museums, art galleries, exhibitions, the theatre, concerts, or the opera) measured in waves 6–8 was used as the exposure variable. Meanwhile self-reported moderate-to-severe pain in wave 9 was used as the outcome variable. Social isolation was considered in waves 6–8, and the possibility of effect modification was captured by assessing each component of the social isolation index: not married or cohabiting with a partner, fewer than monthly contact with children/other immediate family/friends, and not engaging in any organisations, religious groups, or committees.

**Findings** The estimated pain prevalence was 29.2% (95% confidence interval, 28.1–30.3; reference) after adjusting for time-variant, time-invariant, and loss to follow-up factors. Cultural engagement led to a reduction in pain prevalence to 24.1% for all individuals, representing a decrease of 5.1% (95% confidence interval, 0.6–9.6; *P*-value, 0.03). In older people who were not married or cohabiting, cultural engagement resulted in a decrease in pain prevalence to 25.8%, a reduction of 3.4% (95% confidence interval, 0.4–6.4; *P*-value, 0.01). For those with less frequent contact with close family members, the pain prevalence decreased to 25.3%, a reduction of 3.9% (95% confidence interval, 0.2–7.6; *P*-value, 0.03). Meanwhile, other dimensions of social isolation did not show a significant reduction in pain prevalence.

**Interpretation** Cultural engagement may help to reduce the risk of pain in socially isolated older adults. Those who were single or living alone and had less frequent contact with immediate family were particularly vulnerable. While cultural engagement might help certain socially isolated older people feel better, its effectiveness varies, highlighting the need for targeted interventions.

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**Keywords:** Cultural engagement; Cultural activities; Heterogeneity; Modified treatment policy; Social isolation

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## Research in context

### Evidence before this study

We searched a literature search up to November 30, 2023, on PubMed, Cochrane Library, and Web of Science, focusing on the impact of social isolation and loneliness on chronic pain in older adults, using terms like 'social isolation,' 'loneliness,' 'chronic pain,' 'cultural engagement,' and 'older adults.' There is limited evidence regarding how cultural engagement impacts pain in the older people. Specifically, it remains unclear how various aspects of social isolation interact with cultural engagement and potentially alleviate pain.

### Added value of this study

This study employs a novel causal inference-based approach to assess the impact of cultural engagement on the reduction of pain prevalence in older adults. Our analysis reveals that cultural engagement leads to a significant reduction in pain prevalence, particularly among those who are not married or cohabiting and those with less frequent contact with close family members. Specifically, in older individuals who were not married or cohabiting, cultural engagement resulted in a decrease in pain prevalence to 25.8%, a reduction of 3.4% from the initial rate of 29.2%. For those with less frequent contact with close family members, pain prevalence decreased to 25.3%, indicating a reduction of 3.9% from the initial rate. These findings underscore the potential benefits of cultural engagement in reducing the presence of moderate to severe pain, especially among those who are socially isolated. Our results emphasize the necessity of considering social aspects when developing interventions for pain management in older adults.

### Implications of all the available evidence

Our study demonstrates that cultural engagement significantly reduces the prevalence of pain in socially isolated older adults, providing quantifiable evidence for its role in pain management. This underscores the importance of integrating social factors into pain management strategies and highlights the need for interventions that enhance social connectedness, in addition to addressing the physical aspects of pain.

## Introduction

Social isolation is defined as an objective and quantifiable reflection of a smaller social network and lack of social contact,[1,2] and it has been connected to various health-related outcomes, including earlier mortality and depression.[3–7] Recent studies have further highlighted the health implications of social isolation and loneliness, demonstrating a potential increase in susceptibility to serious infections or risk of developing dementia among isolated individuals.[8,9] This underscores the importance of understanding and addressing social isolation in older adults, not only for psychological well-being, but also for broader health outcomes.[10–12] The evaluation of social isolation encompasses multiple characteristics, including marital or cohabiting status, social connectivity, and social activity.[1,2] Living alone, the loss of family or friends, chronic disease, and hearing loss are challenges that older people confront more frequently than other groups, putting them at a higher risk of social isolation.[13–15]

Cultural engagement is one of the psychosocial activities that helps older adults maintain social connectivity while reducing social isolation.[16] Cultural engagement includes various social interactions, such as visiting friends and participating in hobbies and interests. To date, such cultural activities have garnered much attention because of their potential favourable effects, not only on psychological well-being and social isolation but also on overall health and, intriguingly, the management of pain.[10–12] A previous longitudinal study from England found a negative association between cultural engagement and the incidence of pain in older adults.[12] Pain is also thought to be connected with social isolation. A longitudinal study in the USA of people with chronic pain found that social isolation was associated with greater pain interference.[17] As a result, cultural engagement may be useful in lowering the risk of pain by minimizing social isolation. However, due to the dynamic nature of each characteristic of social isolation in older adults, it remains uncertain whether cultural engagement positively influences the reduction of pain risk. In this study, we specifically focused on several key domains of social isolation, which include marital or cohabiting status, frequency of contact with children and other immediate family members, frequency of contact with friends, and participation in organizations, religious groups, or committees.[1,18] These domains were selected to comprehensively capture the multifaceted nature of social isolation among older adults and to understand how each domain uniquely interacts with cultural engagement and its potential to reduce the risk of pain.[1,18]

We hypothesised that engagement in cultural activities with older adults who are socially isolated would minimize the risk of pain. Therefore, using nationally representative longitudinal data from England, this study used a causal inference-based approach to estimate the extent of the influence of cultural engagement in each domain of social isolation on the risk of pain.

## Methods

### Study population

This study constitutes a secondary data analysis, using existing data from waves 6 (2012–2013), 7 (2014–2015), 8 (2016–2017) and 9 (2018–2019) of the English

Longitudinal Study of Ageing (ELSA), a nationally representative panel survey of people over the age of 50 years. The study participants are selected from those who have participated in the Health Survey for England, an annual health examination survey conducted among the general population.[19] The ELSA survey is performed biennially, and physical examinations are performed once every 4 year.[19]

We constructed four waves of panel data, and 7005 participants were eligible for the study. Individuals with missing objectively assessed data (e.g., body mass index and handgrip strength) were excluded from the study. Individuals who answered the baseline survey but did not participate in wave 6, 7, 8, or 9 were included in our analysis and accounted for attrition bias due to loss to follow-up. This study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline.

### Measures

A self-reported questionnaire asked, "Are you often troubled with pain?" for the pain evaluation, and, if so, "How bad is the pain most of the time?" (with options of mild, moderate, or severe). In line with previous studies,[12,20] we focused on the pain rated as moderate or severe for the outcome. In this study, a binary variable for pain assessed in wave 9 was used as an outcome.

To account for the time-varying nature of the exposure, we used cultural engagement as our exposure variable, which was measured in waves 6–8. The frequency of engagement in cultural activities (such as going to museums, art galleries, exhibitions, concerts, the theatre, or the opera) was used to assess cultural engagement. We dichotomised into every other month or more vs. less frequently, following a previous study.[12]

The following domains of the index of social isolation[1,18] were used to assess social isolation: (1) not married or cohabiting with a partner (scored as 1), (2) less than monthly contact with children (scored as 1), (3) less than monthly contact with other immediate families (scored as 1), (4) less than monthly contact with friends (scored as 1), and (5) not participating in any organisations, religious groups, or committees (scored as 1). The index was not summed, but each domain was used independently.

Based on previous studies,[1,12,18,20–24] we used time-invariant and time-variant covariates. We used the following baseline variables for time-invariant covariates: sex (women vs. men), race (white individuals vs. other races), education duration (9–14 year), body mass index ($kg/m^2$), and handgrip strength (kg). Trained nurses measured both body mass index and handgrip strength. Body mass index was calculated by dividing body weight by height squared (normal range is 18.5–29.9).[25] The Smedley handheld dynamometer (Stoelting Co., Chicago, Illinois) was used to measure handgrip strength three times per participant (in the dominant hand). Thus, we calculated the average value and used it to determine handgrip strength. Weak handgrip strength is determined by less than 16 kg in women or 27 kg in men.[26] BMI and handgrip strength were treated as time-invariant variables, using only the measurements from the baseline survey since these variables were measured every four years. Consequently, no information was available for the Wave 7 survey.

We used the following variables for the time-variant covariates: age (continuous), equalised household income (continuous), each social isolation domain (no vs. yes), arthritis (no vs. yes), physical activity (no physical activity at all [no activity monthly], up to moderate physical activity [only moderate physical activity at least 1–3 times a month but no vigorous physical activity at all], or up to vigorous physical activity [vigorous activity at least 1–3 times a month with or without any moderate physical activity]), depressive symptoms (continuous), and pain. Depressive symptoms were measured using the eight-item Centre for Epidemiological Studies Depression Scale (CES-D) with cut-off value for depressive symptoms is four or more.[27]

### Statistical analysis

A descriptive analysis was conducted to outline the characteristics of participants in relation to the study outcome. Chi-squared tests were used for the categorical variables, and t-tests were used for the continuous variables. To estimate the influence of cultural engagement on pain across various social isolation domains, we used a novel causal-inference-based approach with the longitudinal modified treatment policy.[28] This method enables the simulation of different hypothetical cultural engagement scenarios based on the participant's social isolation level at each point. Specifically, the following hypothetical scenarios for prescribing cultural engagements were evaluated (Fig. 1):

(1) "What if participants who were not married or cohabiting with a partner had frequent cultural engagements?"
(2) "What if participants who had less than monthly contact with children had frequent cultural engagements?"
(3) "What if participants who had less than monthly contact with other immediate family had cultural engagement?"
(4) "What if participants who had less than monthly contact with friends had cultural engagement?"
(5) "What if participants who had no participation in organisations, religious groups, or committees had cultural engagement?"

For comparison, we also evaluated the following scenario:

(6) "What if all the participants had frequent cultural engagements?"

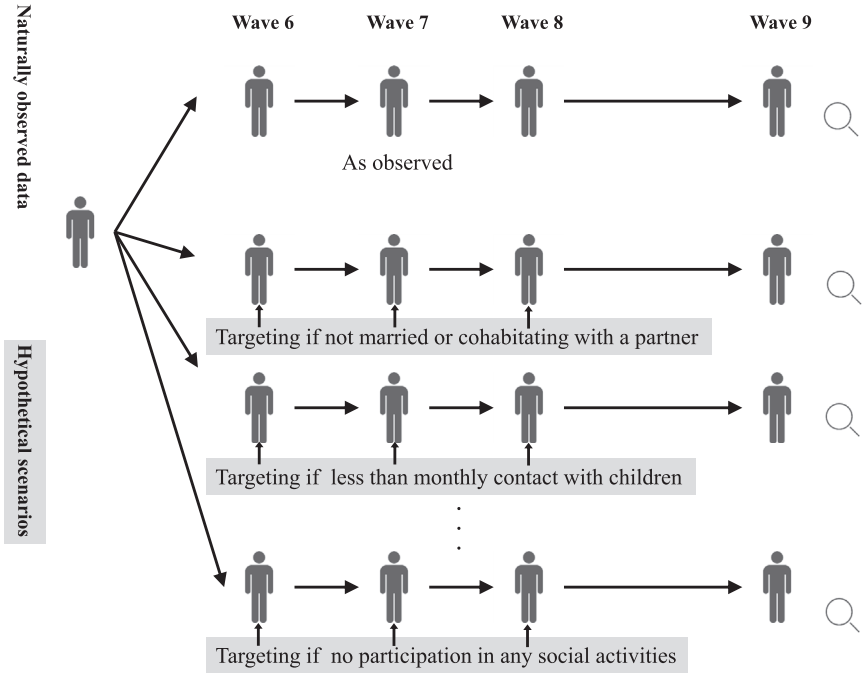


***Fig. 1:*** Schematic of the study design. The top row shows naturally observed data without cultural engagement; the second row shows the hypothetical prescription for participants who reported not being married or living with a partner. The third and following rows represent the same hypothetical prescription based on the social isolation domains. The hypothetical prescription strategy was then compared with the naturally observed data in terms of the risk of pain.

The statistical parameters for the aforementioned emulated scenarios were estimated using the sequential doubly robust estimator.[29] This method is not based on stringent parametric assumptions.[28–32] The sequential doubly robust estimator was applied to estimate the prevalence of pain under both the shifted and naturally observed exposures.[28–32] In this estimation, the probabilities of exposure given covariates (i.e., exposure model) and the conditional probabilities of the outcome given the exposure and covariates (i.e., outcome model) were calculated. An unbiased assessment of counterfactual outcomes is achieved by updating the estimates derived from the result models' inverse probability weights.[30] Therefore, the doubly robust estimation method furnishes unbiased estimates when either model is consistently estimated.[28,29] We used the SuperLearner algorithm for model specifications to improve the robustness of our exposure and outcome models.[33,34] Generalised linear models, generalised additive models, extreme gradient boosting models, and neural networks machine learning methods were used in SuperLearner.

To compute the prevalence and 95% confidence intervals (95% CIs) for each scenario, the estimates for each hypothetical scenario were compared to the result estimate under the naturally observed exposure. Additionally, risk ratios were reported. All estimates were suitably adjusted for the time-invariant and time-variant covariates described above. Estimates also accounted for attrition bias due to loss to follow-up within the study population.[35] We used the multiple imputation method, the chained equation method, and the random forest algorithm to handle missing variables.[36] We conducted three types of sensitivity analyses: first, the cut-off value to define pain was changed from moderate to mild, and we conducted the same analyses. Second, the cut-off value to define having cultural engagement was changed to "every few months or more," and we conducted the same analyses. Third, we calculated the E-value to assess the robustness of our estimation against residual confounding factors.[37] The E-value quantifies the minimum strength of association that any unmeasured confounding factors must have with both cultural engagement and pain. The results from 20 imputed datasets were combined using Rubin's algorithm.[38] All analyses were conducted using R, version 4.2.2.

The National Research and Ethics Committee approved all ELSA waves, and all participants provided informed consent. All ELSA data are anonymous and freely accessible from the UK Data Service (https://beta.ukdataservice.ac.uk/). Therefore, the requirement for obtaining ethics approval for conducting this study was waived.

**Role of the funding source**
The funders had no role in the execution of this study or the interpretation of the results. All authors had full access to all the data in the study and accept responsibility for the decision to submit it for publication.

## Results

The flowchart diagram for the analysis is shown in Fig. 2. After excluding those with missing BMI ($n$ = 328) and handgrip strength ($n$ = 209), the remaining 6468 participants were evaluated in this study. Out of the 6468 participants, 2125 were lost to follow-up during the survey, resulting in 4343 participants who responded to all four waves. Table 1 shows the baseline characteristics of participants based on the outcome. At the follow-up, the following baseline factors were associated with pain: older age, female sex, higher education, not being married or cohabiting with a partner, less than monthly contact with other immediate family members, and not engaging in any organisations, religious groups, or committees. Table 2 depicts the changes in social isolation by domain over time. The data indicates a relatively stable pattern in most domains of social isolation from Wave 6 to Wave 8. Specifically, the percentage of participants not married or cohabitating with a partner increased slightly from 26.8% in Wave 6–29.9% in Wave 8, reflecting a notable social change over time. In contrast, the percentage of participants with less than monthly contact with children remained relatively stable, changing marginally from 16.1% in Wave 6–16.5% in Wave 8. Similarly, the percentage of participants with less than monthly contact with other immediate family members increased from 25.3% in Wave 6–27.2% in Wave 8. The proportion of participants with less than monthly contact with friends increased slightly from 12.0% in Wave 6–13.1% in Wave 8. The percentage of participants not involved in organisations, religious groups, or committees increased slightly from 23.7% in Wave 6–25.5% in Wave 8.

Table 3 shows the estimated pain prevalence at follow-up in relation to the prescription of cultural engagement scenarios after adjusting for covariates and accounting for censoring throughout the follow-up period. The results show that the scenario prescribing cultural engagement to all participants at each time point during the follow-up (estimated prevalence: 24.1%; 95% CI, 19.5–28.8) resulted in the most significant reduction in pain prevalence (estimated difference compared with the naturally observed outcome: 5.1%; 95% CI, 1.0–9.6). Pain prevalence was significantly lower than the naturally observed prevalence in two scenarios where cultural engagement was prescribed based on social isolation status at each time point: the "prescribing if not married or not living with a partner" scenario and the "prescribing if less than one contact per month with other immediate family members" scenario, with estimated differences against the naturally observed outcome of 3.4% (95% CI, 0.4–6.4) and 3.9% (95% CI, 0.2–7.6), respectively. When compared with the naturally observed data, prescribing cultural engagement for individuals who (1) had less than monthly contact with children, (2) had less than monthly contact with friends, and (3) had no participation in any organisations, religious groups, or committees did not significantly reduce the prevalence of pain. The results of our sensitivity analyses, which used a modified cut-off value for pain and cultural engagement, reported findings that were comparable to those of our main analysis (Tables S4 and S5).

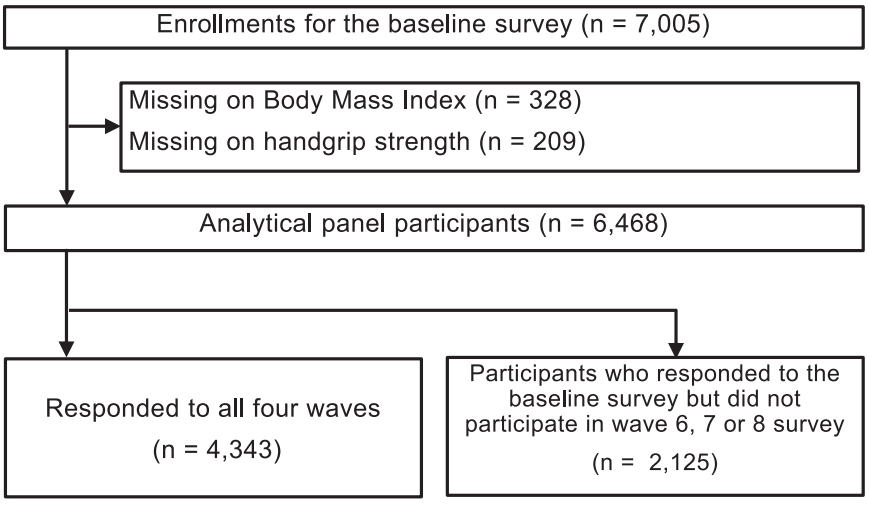


*Fig. 2:* Study flowchart for analytic sample selection over the 6-year follow-up period.

| | Did not report pain in wave 9 | | Reported pain in wave 9 | | *P*-value |
|---|---|---|---|---|---|
| | *N* = 2523 | | *N* = 993 | | |
| Sex | | | | | <0.01[a] |
| Women | 1297 | 51.4% | 648 | 65.3% | |
| Men | 1226 | 48.6% | 345 | 34.7% | |
| Race | | | | | 0.21[a] |
| Other races | 49 | 1.9% | 26 | 2.6% | |
| White individuals | 2474 | 98.1% | 967 | 97.4% | |
| Duration of education, year | | | | | <0.01[a] |
| 9 | 112 | 4.4% | 65 | 6.5% | |
| 10 | 675 | 26.8% | 403 | 40.6% | |
| 11 | 590 | 23.4% | 235 | 23.7% | |
| 12 | 238 | 9.4% | 79 | 8.0% | |
| 13 | 237 | 9.4% | 69 | 6.9% | |
| 14 | 671 | 26.6% | 142 | 14.3% | |
| Not married or cohabitating with a partner | | | | | <0.01[a] |
| No | 1894 | 75.1% | 676 | 68.1% | |
| Yes | 629 | 24.9% | 317 | 31.9% | |
| Less than monthly contact with children | | | | | 0.08[a] |
| No | 2086 | 82.7% | 845 | 85.1% | |
| Yes | 437 | 17.3% | 148 | 14.9% | |
| Less than monthly contact with other immediate family | | | | | 0.02[a] |
| No | 1918 | 76.0% | 717 | 72.2% | |
| Yes | 605 | 24.0% | 276 | 27.8% | |
| Less than monthly contact with friends | | | | | 0.14[a] |
| No | 2245 | 89.0% | 866 | 87.2% | |
| Yes | 278 | 11.0% | 127 | 12.8% | |
| Not participating in any organizations, religious groups, or committees | | | | | <0.01[a] |
| No | 1986 | 78.7% | 718 | 72.3% | |
| Yes | 537 | 21.3% | 275 | 27.7% | |
| Having arthritis | | | | | <0.01[a] |
| No | 1944 | 77.1% | 439 | 44.2% | |
| Yes | 579 | 22.9% | 554 | 55.8% | |
| Having pain | | | | | <0.01[a] |
| None | 1826 | 72.4% | 292 | 29.4% | |
| Mild | 324 | 12.8% | 128 | 12.9% | |
| Moderate | 324 | 12.8% | 416 | 41.9% | |
| Severe | 49 | 1.9% | 157 | 15.8% | |
| Physical activity | | | | | <0.01[a] |
| No physical activity at all | 162 | 6.4% | 176 | 17.7% | |
| Up to moderate physical activity | 1099 | 43.6% | 465 | 46.8% | |
| Up to vigorous physical activity | 1262 | 50.0% | 352 | 35.4% | |
| Age (year), mean (*SD*) | 66.7 | 7.7 | 67.8 | 7.9 | <0.01[b] |
| Equivalised household income (£), mean (*SD*) | 452.6 | 583.2 | 364 | 637.8 | <0.01[b] |
| Depressive symptoms (CES-D), mean (*SD*) | 0.9 | 1.5 | 1.7 | 2.1 | <0.01[b] |
| Body mass index, mean (*SD*) | 27.8 | 4.7 | 29.8 | 5.6 | <0.01[b] |
| Hand grip strength, mean (*SD*) | 30.5 | 10.4 | 26.3 | 10.5 | <0.01[b] |

*Note*. Values are presented as numbers and percentages unless otherwise stated. Wave 9, 2018–2019. Abbreviations: CES-D, Centre for Epidemiologic Studies Depression Scale; *SD*, standard deviation. [a]chi-squared test was performed. [b]t-test was performed.

***Table 1:*** **Baseline characteristic of participants who responded to all four waves by pain at follow-up (England: 2012–2014–2016–2018).**

## Discussion

Our study revealed that cultural engagement significantly reduced pain prevalence over a 6-year follow-up period among older adults, particularly for those who were not married or cohabiting and those with less frequent contact with other immediate family members. However, increased engagement in cultural activities across the entire study population was associated with only a modest reduction in the prevalence. Specifically, people who met with their children and friends less than once a month, and those who did not participate in organisations, religious groups or committees, did not show significant benefits from increased cultural engagement.

Our findings have clinical implications in that prescribing cultural engagement, in the context of social prescribing, that is, ways to connect patients to sources of social support and social activities within the community, may be a strategy for alleviating the burden arising from pain.[39,40] Cultural engagement was especially successful in our study for older adults who were not married or cohabiting with a spouse and had little interaction with direct family members. This suggests that the effects of cultural engagement on the reduction of pain prevalence were heterogeneous. Therefore, prescribing cultural activities to such high-risk populations may be useful in effectively reducing the prevalence of pain.

Social isolation is a significant aspect of pain-related assessment and coping, and it has been shown to minimise the impact of pain in those who have a strong sense of participation and inclusion with others.[17] This implies that social connectedness and community engagement are essential variables in lowering pain sensation and impact. A recent Japanese study on the effects of COVID-19 found that increasing loneliness and social isolation were positively connected with pain prevalence/incidence, pain intensity, and previous/present chronic pain.[41] Furthermore, pain is affected by social isolation sensitivity, with people who have a strong sense of engagement and inclusion with others experiencing a significantly reduced impact of pain.[42] Social isolation has a negative effect on the health and quality of life of individuals. Individuals who are isolated from their families are more prone to suffer from chronic health issues. To increase overall well-being, it is critical to address and alleviate social isolation.[43]

Those who were not married or cohabiting and those who had less frequent contact with close family members gained the most from cultural engagement among the socially isolated categories. This implies that some aspects of social isolation may be more accessible to intervention through cultural activities than others. This phenomenon may be influenced by social support. Friends and spouses are often vital sources of social

| | Wave 6 | | Wave 7 | | Wave 8 | |
|---|---|---|---|---|---|---|
| Not married or cohabitating with a partner | | | | | | |
| No | 2996 | 73.2% | 2888 | 71.9% | 2792 | 70.1% |
| Yes | 1097 | 26.8% | 1129 | 28.1% | 1193 | 29.9% |
| Less than monthly contact with children | | | | | | |
| No | 3324 | 83.9% | 3262 | 83.6% | 3262 | 83.5% |
| Yes | 640 | 16.1% | 638 | 16.4% | 646 | 16.5% |
| Less than monthly contact with other immediate family | | | | | | |
| No | 2984 | 74.7% | 2937 | 74.5% | 2835 | 72.8% |
| Yes | 1010 | 25.3% | 1007 | 25.5% | 1060 | 27.2% |
| Less than monthly contact with friends | | | | | | |
| No | 3565 | 88.0% | 3446 | 87.2% | 3418 | 86.9% |
| Yes | 484 | 12.0% | 506 | 12.8% | 513 | 13.1% |
| Not participating in any organizations, religious groups, or committees | | | | | | |
| No | 3037 | 76.3% | 2933 | 75.8% | 2842 | 74.5% |
| Yes | 942 | 23.7% | 934 | 24.2% | 975 | 25.5% |

*Note*. Wave 6, 2012–2013; Wave 7, 2014–2015; Wave 8, 2016–2017.

***Table 2*: Changes in social isolation status of participants who responded to all four waves (England: 2012–2014–2016–2018).**

support.[44] Richmond et al.[45] investigated the association between pain and social care and found that those who received low social care experienced more pain after 6 weeks than those who received high social care. Pain and social support were found to have a strong association, with HIV-infected men who received social support having a reduction in pain.[46] Studies in adolescents have shown that increased familial support and parental involvement help reduce the impact of pain on daily activities.[47] Another factor to examine is the impact of relationships with spouses and friends on losing emotional connection. Individuals who have lost a romantic partner or spouse typically suffer from significant emotional pain and stress as a result of the severed relationship.[48] Individuals in this situation may place a greater value on the sentiments of comfort, consolation, and connection produced by cultural engagement. Cultural activities, particularly for these populations, may bring comfort and connection, alleviating pain.

One potential reason for the limited impact of cultural activities on the reduction of pain prevalence across the entire study population could be the presence of alternative support systems. In particular, individuals who had infrequent contact with their children and friends (less than once a month) or those not involved in organisations, religious groups, or committees appeared to derive less benefit from these cultural interventions. Individuals, for example, may be able to acquire social support via sources other than traditional ones. Caring for pets, for example, can provide emotional consolation; those who have an emotional connection with their pets have reported feelings of love, joy, and peace. Notably, dog owners have shown a much lower prevalence of dementia.[49] Furthermore, engagement in online communities has been found to reduce discomfort associated with depression.[50] Such alternate support mechanisms may be sufficient for pain and its effects. Furthermore, the nature of the cultural activities that older individuals engage in can also play a role. Those who are closer in age, such as spouses, partners, and other near family members, excluding children (e.g., siblings and cousins), may be more likely to participate in cultural activities together. This shared experience has the potential to magnify the advantages received from such interactions. Table S3 shows differences in cultural engagement impacted by social isolation factors. More than 80% of individuals who were not married or did not live with a spouse did not participate in cultural events regularly. A similar trend was observed among people who had limited interaction with family or friends. This implies that social isolation may have an impact on involvement in cultural activities and the

| | Prevalence of pain | 95% CI | | Difference | 95% CI | | Risk ratio | E-value |
|---|---|---|---|---|---|---|---|---|
| Naturally observed data | 0.292 | 0.281 | 0.303 | Reference | | | | |
| All participants had a cultural engagement | 0.241 | 0.195 | 0.288 | **−0.051** | **−0.096** | **−0.006** | **0.83** | **1.72** |
| Targeting individuals who met each social isolation domain question | | | | | | | | |
| Not married or cohabitating with a partner | 0.258 | 0.226 | 0.290 | **−0.034** | **−0.064** | **−0.004** | **0.88** | **1.52** |
| Less than monthly contact with children | 0.290 | 0.269 | 0.311 | −0.002 | −0.019 | 0.015 | 0.99 | 1.09 |
| Less than monthly contact with other immediate family | 0.253 | 0.214 | 0.292 | **−0.039** | **−0.076** | **−0.002** | **0.87** | **1.58** |
| Less than monthly contact with friends | 0.276 | 0.253 | 0.298 | −0.017 | −0.037 | 0.004 | 0.95 | 1.31 |
| Not participating in any organizations, religious groups, or committees | 0.294 | 0.248 | 0.341 | 0.002 | −0.043 | 0.048 | 1.01 | 1.09 |

*Note*. Statistical significance at $P < 0.05$ is indicated in **bold**. All models were adjusted for baseline (wave 6) covariates, including age, sex, race, education, equalised household income, each social isolation index domain, arthritis, depressive symptoms, physical activities, handgrip strength, body mass index, and pain. All models in waves 7 and 8 were also adjusted for covariates, including equalised household income, each social isolation index domain, arthritis, depressive symptoms, physical activities, and pain. Abbreviation: 95% CI, 95% confidence interval.

***Table 3*: The estimated pain prevalence, and 95% confidence intervals calculated by comparing emulated scenarios with the naturally observed outcome estimate.**

potential advantages received from them. According to an ELISA study, older adults who participated in receptive arts activities, such as trips to museums, galleries, and exhibitions, had a lower risk of feeling lonely. Specifically, those who participated in these cultural activities every few months or more often had a much-decreased likelihood of experiencing loneliness than those who did not.[51] This shows that cultural activity may play a role in fostering social relationships and reducing feelings of isolation among older people. In conclusion, given the criteria indicated, cultural engagement may serve as a support and palliative measure for the loss of emotional connection and changes in everyday life, which may contribute to the reduction of pain prevalence.

This study has several limitations. The first limitation of this study is the use of non-validated questions for assessing both the exposure and the outcome variable. The questions used in ELSA have not undergone a formal validation process for measuring cultural engagement, social isolation, or pain. This lack of validated measures may affect the precision and reliability of our findings. Additionally, we acknowledge the need for a more nuanced understanding of the pain assessment used in our study. While we have identified the limitations of using non-validated questions from ELSA for measuring pain, it is important to note that these questions, despite their limitations, were selected due to their practical applicability in a large-scale survey context. The absence of a specific time frame for pain recall in our questions may lead to a broader interpretation of pain experiences, encompassing both acute and chronic pain. This aspect underscores the complexity of pain assessment in large-scale epidemiological studies and highlights the necessity for future research to develop and incorporate more targeted and validated measures for pain assessment, particularly in the context of older adults. Second, a causal inference approach using observational studies with time-varying exposures requires the assumption of unmeasured confounding at each time point.[52] As a result, our findings could be influenced by unmeasured confounding. Moreover, we did not treat BMI and handgrip strength as time-variant variables because these variables were not measured in Wave 7 survey. However, the calculated E-values suggested that the observed estimates were moderately robust against unmeasured confounders for causality. Third, due to attrition throughout the 6-year follow-up survey, more than 30% of the eligible individuals were excluded (Fig. 2). Additionally, we did not account for non-response in the baseline survey, potentially introducing selection bias. Nevertheless, we carefully accounted for this attrition bias caused by loss to follow-up.[35] Fourth, we addressed the different domains of social isolation independently and have not been able to examine the extent to which cultural engagement may be effective in reducing the prevalence of pain in participants who fall into more than one category of social isolation. Therefore, future research is warranted.

In conclusion, our findings highlight the potential benefits of cultural engagement in reducing the presence of moderate to severe pain, especially among those who are socially isolated. These findings highlight the need to take social aspects into account when developing interventions for pain management in older adults. More extensive research is needed to confirm these findings and to explore the underlying mechanisms that relate to cultural engagement, social isolation, and health outcomes.

#### Contributors

Dr. Miki takes responsibility for the integrity of the data and the accuracy of the data analysis. Dr. Miki was also involved in the concept and design of the study, acquisition, analysis, and interpretation of data, drafting of the manuscript, verifying the underlying data, and statistical analysis.

Dr. Ikeda shared responsibility with Dr. Miki for the integrity and accuracy of the data analysis. Dr. Ikeda contributed to the concept and design of the study, acquisition, analysis, and interpretation of data, and played a key role in drafting and critically revising the manuscript.

Dr. Cooray provided supervision throughout the study and contributed to the concept and design, critical revision of the manuscript for important intellectual content, and statistical analysis.

Dr. Kanai was involved in the concept and design of the study and provided supervision and critical intellectual input into the manuscript.

Mr. Hagiwara contributed to the concept and design of the study and provided supervision and critical revision of the manuscript for important intellectual content.

All authors reviewed and approved the final version of the manuscript. In addition, all authors had full access to all the data in the study and accept responsibility for the decision to submit it for publication.

#### Data sharing statement

ELSA data were made available through the UK Data Archive (https://beta.ukdataservice.ac.uk/) and are widely available in this way; therefore, our study data will not be made available for access.

#### Declaration of interests

The authors declare no conflict of interest.

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#### Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.eclinm.2024.102477.

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