Arts, mental distress, mental health functioning & mental wellbeing: fixed-effects analyses of a nationally-representative panel study

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Abstract

Background

Arts engagement within communities is ubiquitous across cultures globally and previous research has suggested benefits for mental health and wellbeing. However, it remains unclear whether these benefits are due to the confounding impact of factors such as socio-economic status (SES), childhood arts engagement, previous mental health, personality, or self-selection bias. So this study used fixed effects models that account for even unidentified time-constant confounding measures to examine the longitudinal association between arts (frequency of both arts participation and cultural attendance), mental distress, mental health functioning, and mental wellbeing.

Methods

Data from 23,660 individuals (with a mean age of 47 years) included in the UK Understanding Society wave 2 (2010-2012) and wave 5 (2013-2015) were analyzed. Changes in frequencies of art engagement were related to changes in mental health within individual over time whilst accounting for time-varying confounders.

Results

After controlling for all time-constant variables and identified time-varying confounders, frequent arts participation and cultural attendance were associated with lower levels of mental distress and higher levels of life satisfaction, with arts participation additionally associated with higher mental health functioning. Health-related and social time-varying factors were shown to partly but not wholly explain the observed associations.

Conclusion

Arts engagement amongst the population as a whole may help enhance positive mental health and wellbeing, and protect against mental distress. These results are not explained by any time-constant confounding factors.
Introduction

Arts engagement within communities is ubiquitous across cultures globally. In the UK alone, there are estimated to be over 40,000 choirs [1], 11,000 amateur orchestras [2], 50,000 amateur arts groups [2], 50,000 book clubs [3], 5,000 amateur theatre societies [2], 3,000 dance groups [2], 2,500 museums [4], and 1,300 theatres [5]. Previous research has suggested that arts engagement has beneficial effects for both mental health and well-being [6–9]. It has been suggested that this could be due to multiple factors including arts activities enhancing self-identity through the pursuit of skills, stimulation of creativity and self-expression [10], facilitating self-esteem and self-efficacy [11], building an individual’s social identity [12], reducing psychological and biological markers of stress [13], provide cognitive stimulation [14, 15], enhancing social support [16, 17], reducing sedentary behaviours associated with depression [18], and supporting coping skills [19–21].

However, there are a number of other factors that could explain this association. For example, arts engagement is socially patterned, with engagement in adult life related to broader social and cultural capital as well as education, income, engagement in childhood and the engagement of parents and wider peer groups [22, 23]. Similarly, arts engagement has been shown to vary based on childhood engagement and the engagement patterns of friends and family as an individual transitions to adulthood [24], and based on previous mental health [25]. Personality too has been shown to affect attitudes towards arts engagement [26]. As these factors are all themselves associated with mental health, it is possible that associations between arts and mental health could in fact be due to individual confounding factors [27, 28]. This is the case both for intervention studies, for which self-selection bias is likely to predispose individuals with higher levels of cultural capital, greater past experience, better previous mental health and open personality types.
to take part, and for analyses of observational data, which have, to date, largely involved cross-sectional associations [29]. Even longitudinal analyses that adjust for such factors still may not entirely remove their effects [30]. Therefore, to address these issues we analyzed data from a large-scale nationally-representative longitudinal cohort study using a sophisticated statistical technique commonly used in causal inference research that automatically accounts for all time-invariant factors (even if unobserved) as well as allowing the modelling of time-varying confounders.

Method

Participants

This study used data from Understanding Society: The UK Household Longitudinal Study (UKHLS), which provides high-quality longitudinal panel data comprising a stratified and clustered General Population Sample of around 40,000 households. These analyses used data from wave 2 (2010-2012) and wave 5 (2013-2015) when questions on arts activities/cultural events were included. Of 54,554 respondents in wave 2, 37,389 were followed up in wave 5, and 25,051 of these (around 67%) responded to self-completion questionnaires on health and arts. After deleting 1,391 cases with missing information (around 5%), the final analytic sample includes 23,660 respondents and 47,320 person-wave observations. Longitudinal weights provided by the UKHLS were used to adjust for the complex survey design, non-response rate, unequal selection probabilities and non-random attrition across waves.

Measures

Arts engagement was measured using 28 separate questions that were categorised into “activities” or “events”. Arts activities included dance (including ballet), singing to an audience or rehearsed for a performance (not karaoke), playing a musical instrument,
writing music, rehearsing/performing in a play/drama, opera/operetta or musical theatre, taking part in a carnival/street arts event, learning or practising circus skills, painting, drawing, printmaking or sculpture, photography, film or video making as an artistic activity, using a computer to create original artworks or animation, taking part in textile crafts, wood crafts or any other crafts such as embroidery, knitting, reading for pleasure (not newspapers, magazines or comics), writing any stories, plays or poetry, or being a member of a book club where people meet up to discuss and share books. Cultural events included attending a film at a cinema or other venue, an exhibition or collection of art, photography, sculpture or a craft exhibition, an event which included video or electronic art, an event connected with books or writing, street arts or a public art display or installation, a carnival or cultural specific festival, a circus (not animals), a play/drama, pantomime or musical, an opera/operetta, a classical music performance, a rock, pop or jazz performance, a ballet, a contemporary dance performance, or an African people’s dance or South Asian and Chinese dance. For each question frequency of arts engagement was measured using five categories for arts participation (never, once/twice per year, once per month, once per week, more than once per week), and four categories for cultural attendance (never, once/twice per year, once per month, once per week or more). Given the well-known distinctions between mental health and multidimensional wellbeing [31], we explored three aspects of mental health. Mental distress was measured with GHQ-12 (General Health Questionnaire); a well-validated scale derived from 12 items to measure the levels of respondents’ psychiatric illness. Items include depressive and anxiety symptoms, sleeping problems, and overall happiness [32]. UKHLS converts the answers to GHQ-12 questions to a single continuous scale ranging from 0 (the least distressed) to 12 (the most distressed), with a lower score indicating better mental health. Functioning as a result of mental functioning was measured using SF-12 (12-Item Short
Form Health Survey); a widely used and reliable instrument that measures respondents’ general quality of life that focuses both on mental and physical health, with a particular emphasis on the implications of any problems for ability to function as normal in everyday life [33]. The survey contains eight indicators formed of 12 items: physical functioning (2 items), role limitations due to physical health problems (2 items), bodily pain (1 item), general health (1 item), vitality (1 item), social functioning (1 item), role limitations due to emotional problems (2 items), and mental health (2 items) [33]. UKHLS calculates the SF-12 Mental Component Summary (MCS) score by assigning higher weights to mental health related items (the latter six items). The MSC score ranges from 0 (the lowest mental functioning) to 100 (the highest mental functioning).

Subjective wellbeing comprises both affective aspects (such as happiness and pleasure in daily life and being free from negative affect) as well as cognitive-evaluative aspects (such as life satisfaction) [34]. We focused specifically on life satisfaction. This was measured using a single-item “overall, how satisfied are you with your life nowadays?” Responses ranged from 1 (completely unsatisfied) to 7 (completely satisfied) [35].

We controlled for a wide range of variables, which were shown to influence both mental health and participation in arts activities or events. Demographic characteristics included age, age squared, marital status (never married, married/cohabited, divorced/separated/widowed), presence of children in the household (no children, preschool children aged 0-4, primary school children aged 5-11, middle school children aged 12-15), employment status (inactive, unemployed, working class, intermediate class, service class), number of people in household, logged household income and wave. Health behaviour variables included portions of fruits or vegetables eaten per day, smoking behaviour (current smoker, ever smoked, never smoked), and drinking frequency in the last year with eight categories from 1 (never drink) to 8 (drink every day), physical
activity frequency with 11 categories from 0 (not physically active) to 10 (very active). We also controlled for extent to which health limits moderate activities in the second set of covariates. Controlling for the extent to which health limits moderate activities (rather than broader physical health) could to some extent capture the health selectivity in participating arts activities or events. Social support variables included family support and friend support measured using three questions with a 4-point scale from 1 (not at all/no family or friends) to 4 (a lot): family/friends understand the way I feel; I can rely on family/friends; I can talk about my worries with family/friends. Principal component factor analyses were conducted to extract one factor for family support (eigenvalue = 2.35, variance explained = 78%, alpha = 0.86) and one factor for friend support (eigenvalue = 2.45, variance explained = 82%, alpha = 0.89). For more details about the distribution of variables, see Table 1.

Statistics

Using Stata 14, we performed fixed effects (FE) regression analyses. Compared with ordinary least square regression, which does not distinguish between within- and between-person variation, FE regression only focuses on within-person variation, examining how changes in frequencies of art engagement are linked to changes in mental health within each individual over time (Allison, 2009). In doing this, FE regression eliminates the confounding effects from all time-constant variables (e.g. gender, ethnicity, social class, personality, previous arts engagement, previous mental health, education etc). As such, these factors cannot explain any association found. Further, FE regression considers time-varying confounders at both waves, not just at baseline, capturing their dynamic relationship with the exposure and outcome to better estimate the causal relationship. For more detail on analyses see Supplementary Material.

We fitted nested models adding covariates stepwise. Model 1 automatically adjusted for
time-constant variables. Model 2 controlled for time-varying demographic characteristics and wave. Model 3 additionally controlled for time-varying health behaviors and social support. However, as the factors in Model 3 could be seen to lie on the causal pathway (which would make adjusting for them inappropriate), Model 2 may present more appropriate estimates. We further assessed whether age and gender were moderators through including interaction terms.

Although the panel data only consist of two waves, the key variables in this study such as mental health, frequencies of art engagement have enough within variation (on average 35% of total variation is from within variation) allowing for accurate estimation of FE regression analysis (Allison, 2009).

Data were strongly balanced. A Hausman test to confirm the selection of a fixed effects over a random effects model. The modified Wald test for group-wise heteroscedasticity was significant so sandwich estimators were applied. Coefficients for all years were not jointly equal to zero, so time-fixed effects were included in the model.

Results

Descriptive statistics

Table 1 reports descriptive statistics for the sample as a whole and by arts engagement. At baseline, people who were frequently engaged in arts had lower levels of mental distress and higher levels of mental functioning and life satisfaction than those who are infrequently engaged as well as better health behaviors, more social support from family and friends, and higher socioeconomic status. Mental distress showed a negative correlation with mental functioning \( (r=-0.73, \ p<.001) \) and life satisfaction \( (r=-0.49, \ p<.001) \), while mental functioning and life satisfaction were positively correlated \( (0.47, \ p \ < \ .001) \).

Table 1. Descriptive statistics
Mental distress
When adjusting for all identified confounders, significantly lower levels of mental distress were found amongst those who participated in arts activities more than once a week (coef. -0.29, 95% CI -0.56, -0.01), or who attended cultural events once a week or more (coef. -0.42, 95% CI -0.76, -0.08) (Table 2).

Mental functioning
When accounting just for time-constant factors, participation in arts activities was associated with significantly higher mental functioning (coef. 0.66, 95% CI 0.21, 1.22), with this result maintained when considering all time-varying confounders (coef. 0.50, 95% CI 0.05, 0.95) (Table 2). The association between attending cultural events and mental functioning shown when just accounting for time-constant factors (coef. 0.63, 95% CI 0.05, 1.22) was attenuated when controlling for time-varying confounders.

Subjective wellbeing: life satisfaction
When adjusting for all identified confounders, people who participated in arts activities more than once a week (coef. 0.09, 95% CI 0.01, 0.17), or who attended cultural events at least once/twice per year (coef. 0.13, 95% CI 0.05, 0.21) had significantly higher life satisfaction than those who have not participated in these art activities or cultural events (Table 2).

Table 2. Fixed effects models predicting the associations between frequencies of art engagement & mental health

Discussion
This study showed a significant relationship between both frequent arts participation and cultural attendance and lower levels of mental distress and higher levels of life
satisfaction. This result was particularly strong for life satisfaction, for which there were associations also from less frequent cultural attendance.

Our results confirm that the relationship between arts engagement and multiple different aspects of mental health is not merely an artefact of time-constant socio-economic factors. This suggests that while arts engagement is associated with broader aspects of social and cultural capital and socio-economic status (which are themselves associated with health) [27], the relationship cited in previous studies is independent of these factors. Further, our analyses automatically accounted for other time-constant factors such as personality, previous arts engagement, and previous mental health. But it confirmed that the relationship with mental health is not explained by these either.

In considering, therefore, how arts activities can affect mental health, arts engagement can be considered as a ‘complex’ or ‘multi-modal’ health-promoting activity in that it combines multiple health-promoting or risk-reducing factors such as gentle physical activity, social interaction, relaxation, emotional expression, and cognitive stimulation [37]. But our analyses shed further light onto the causal mechanisms that could link arts and mental health. We found a relationship with higher mental health functioning only with arts participation; not cultural attendance. As cultural attendance is associated with improved mental distress and wellbeing directly but not functioning, this suggests a direct relationship with affective symptoms (such as reductions in negative feelings and stress hormones and enhanced feelings of happiness) but not with an ability to alter psychological or behavioural factors relating to coping with affective symptoms. However, arts participation does show a relationship with mental functioning. As the only major distinction between the two types of arts engagement is the participation itself, as other elements of the two types of activities (e.g. aesthetic engagement, gentle physical activity, social interaction etc) are consistent, this suggests it is participation that
supports coping. In support of this, intervention studies have identified improvements in aspects of functioning such as self-efficacy, agency and purpose as a result of arts participation [38].

Our results are limited due to only having data across two waves of UKHLS which do not permit lagged analyses, and it is possible that residual confounding for time-varying factors remains. But as all time-constant factors are automatically considered and the data allowed us to include all identified confounders, remaining unobserved heterogeneity should be small. Our analyses also focused on broad categories of arts engagement. Future research may like to consider different types of arts or cultural activities in greater detail and consider how access to activities within communities may affect abilities to engage.

CONCLUSIONS

Overall, our results suggest that reported associations between arts and mental health are not merely driven to socio-demographic, historical or personality-based factors. In addition to having mental health benefits amongst specific samples such as those with mental or physical illness, encouragement of arts engagement amongst the population as a whole could help to promote both mental health and wellbeing.

List Of Abbreviations

UKHLS = UK Household Longitudinal Study
GHQ-12 = General Health Questionnaire
SF-12 = 12-Item Short Form Health Survey
MCS = Mental Component Summary
FE = fixed effects

Declarations

Ethics approval and consent to participate
The University of Essex Ethics Committee has approved all data collection on Understanding Society main study and innovation panel waves, including asking consent for all data linkages except to health records.

Consent for publication
Not applicable.

Availability of data and materials
UKHLS data is available from the UK Data Service https://discover.ukdataservice.ac.uk/catalogue/?sn=6614. Data documentation is available from the Understanding Society website https://www.understandingsociety.ac.uk/documentation.

Competing interests
All authors declare no competing interests.

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Authors’ contributions
SW conducted the data management, data analyses and provided input on the manuscript.
HWM and DF assisted with analytical issues, provided input on the analytical scheme and the manuscript. All authors read and approved the final manuscript.
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References
1. Voices Now: Big Choral Census (UK). https://musiceducationuk.com/resources/voices-now-big-choral-census-uk/. Accessed 19 Jan 2018.
2. Our Creative Talent – the voluntary and amateur arts in England | CultureHive. http://www.culturehive.co.uk/resources/our-creative-talent-the-voluntary-and-amateur-arts-in-england/. Accessed 19 Jan 2018.
3. Hartley J. Reading Groups. Oxford University Press; 2001.
4. FAQs | Museums Association. https://www.museumsassociation.org/about/frequently-asked-questions. Accessed 19 Jan 2018.
5. How many theatres are there in the UK? Theatres Trust. http://www.theatrestrust.org.uk/discover-theatres/theatre-faqs/167-how-many-theatres-are-there-in-the-uk. Accessed 19 Jan 2018.
6. Curtis A, Gibson L, O’Brien M, Roe B. Systematic review of the impact of arts for health activities on health, wellbeing and quality of life of older people living in care homes. Dementia. 2018;17:645-69.
7. Fujiwara D, Kudrna L, Dolan P. Quantifying and Valuing the Wellbeing Impacts of Culture and Sport. 2014. https://www.gov.uk/government/publications/quantifying-and-valuing-the-wellbeing-impacts-of-culture-and-sport. Accessed 20 May 2015.
8. Gold C, Voracek M, Wigram T. Effects of music therapy for children and adolescents with psychopathology: A meta-analysis. J Child Psychol Psychiatry. 2004;45:1054-63.
9. Zarobe L, Bungay H. The role of arts activities in developing resilience and mental wellbeing in children and young people a rapid review of the literature. Perspect Public Health. 2017;137:337-47
10. Maslow AH. Toward a Psychology of Being. Simon and Schuster; 2013.

11. Franklin M. Art Therapy and Self-Esteem. Art Ther. 1992;9:78–84.

12. Davidson L, Strauss JS. Sense of self in recovery from severe mental illness. Br J Med Psychol. 1992;65 (Pt 2):131–45.

13. Finn S, Fancourt D. The biological impact of listening to music in clinical and nonclinical settings: A systematic review. 1st edition. Elsevier B.V.; 2018.

14. Camic PM, Chatterjee HJ. Museums and art galleries as partners for public health interventions. Perspect Public Health. 2013;133:66–71.

15. Wang S, Blazer DG. Depression and Cognition in the Elderly. Annu Rev Clin Psychol. 2015;11:331–60.

16. Cohen S, Wills TA. Stress, social support, and the buffering hypothesis. Psychol Bull. 1985;98:310–57.

17. Cohen G. Research on Creativity and Aging: The Positive Impact of the Arts on Health and Illness. Generations. 2006;30:7–15.

18. Teychenne M, Ball K, Salmon J. Sedentary behavior and depression among adults: a review. Int J Behav Med. 2010;17:246–54.

19. Hutchinson SL, Loy DP, Kleiber DA, Dattilio J. Leisure as a Coping Resource: Variations in Coping with Traumatic Injury and Illness. Leis Sci. 2003;25:143–61.

20. Perkins R, Yorke S, Fancourt D. How group singing facilitates recovery from the symptoms of postnatal depression: a comparative qualitative study. BMC Psychol. 2018;6:41.

21. Perkins R, Ascenso S, Atkins L, Fancourt D, Williamon A. Making music for mental health: how group drumming mediates recovery. Psychol Well-Being. 2016;6:11.

22. Blood I, Lomas M, Robinson M. Every child : equality and diversity in arts and culture with, by and for children and young people. 2016.
23. Bourdieu P. The forms of capital. Cult Theory Anthol. 1986;1:81–93.

24. Elsley S, McMellon C. Starting young? Links between childhood and adult participation in culture and science: A literature review. 2010.

25. Jensen A. Mental health recovery and arts engagement. J Ment Health Train Educ Pract. 2018;13:157–66.

26. McManus IC, Furnham A. Aesthetic activities and aesthetic attitudes: Influences of education, background and personality on interest and involvement in the arts. Br J Psychol. 2006;97:555–87.

27. Pinxten W, Lievens J. The importance of economic, social and cultural capital in understanding health inequalities: using a Bourdieu-based approach in research on physical and mental health perceptions. Sociol Health Illn. 2014;36:1095–110.

28. Kendler KS, Gatz M, Gardner CO, Pedersen NL. Personality and Major Depression: A Swedish Longitudinal, Population-Based Twin Study. Arch Gen Psychiatry. 2006;63:1113–20.

29. Wheatley D, Bickerton C. Subjective well-being and engagement in arts, culture and sport. J Cult Econ. 2017;41:23–45.

30. Becher H. The concept of residual confounding in regression models and some applications. Stat Med. 1992;11:1747–58.

31. Keyes CL. Mental Illness and/or Mental Health? Investigating Axioms of the Complete State Model of Health. J Consult Clin Psychol. 2005;73:539–48.

32. Goldberg DP. User’s guide to the General Health Questionnaire. Windsor. 1988.

33. Ware J, Kosinski M, Keller S. How to Score the SF-12 Physical and Mental Health Summary Scales. Boston; 1998.

34. Keyes CLM, Shmotkin D, Ryff CD. Optimizing well-being: The empirical encounter of two traditions. J Pers Soc Psychol. 2002;82:1007–22.
35. Dolan P, Layard R, Metcalfe R. Measuring subjective well-being for public policy. 2011.

36. Mcmanus IC, Furnham A. Aesthetic activities and aesthetic attitudes: Influences of education, background and personality on interest and involvement in the arts. Br J Psychol. 2006;97:555-87.

37. Craig P, Rahm-Hallberg I, Britten N, Borglin G, Meyer G, Köpke S, et al. Researching Complex Interventions in Health: The State of the Art. BMC Health Serv Res. 2016;16:101.

38. Ascenso S, Perkins R, Atkins L, Fancourt D, Williamson A. Promoting well-being through group drumming with mental health service users and their carers. Int J Qual Stud Health Well-Being. 2018;13.

Table

Table 1. Descriptive statistics

| Items                        | Variables (min. and max. values) | Whole sample %/ M (SD) | Less than once per week %/M (SD) | Once %/ M (SD) |
|------------------------------|----------------------------------|------------------------|----------------------------------|----------------|
| Participation in arts activities | None                             | 18.91                  |                                  |                |
|                              | Once/twice last year             | 3.24                   |                                  |                |
|                              | Once per month                   | 8.09                   |                                  |                |
|                              | Once per week                    | 13.57                  |                                  |                |
|                              | More than once per week          | 56.19                  |                                  |                |
| Attendance at arts events    | None                             | 20.86                  |                                  |                |
|                              | Once/twice last year             | 24.82                  |                                  |                |
|                              | Once per month                   | 36.06                  |                                  |                |
|                              | Once per week or more            | 18.25                  |                                  |                |
| Mental health conditions     | GHQ-12 mental distress (0-36)    | 11.16 (5.53)           | 11.35(5.64)                      | 11.00          |
|                              | SF-12 mental functioning (0-100) | 49.55 (9.74)           | 49.14(10.08)                     | 50.05          |
| Demographic characteristics  | Age (16-101)                     | 47.19 (18.01)          | 46.93(16.63)                     | 49.59          |
|                              | Age groups                        |                        |                                  |                |
|                              | <30                               | 15.92                  | 18.42                            | 14.83          |
|                              | 31-40                             | 17.35                  | 19.11                            | 16.58          |
|                              | 41-50                             | 21.11                  | 22.27                            | 20.61          |
| Age group | 51-60 | 55-60 | 60-65 |
|-----------|-------|-------|-------|
| 17.76     | 18.44 | 18.73 |
| 22.44     | 27.19 | 29.25 |

Marital status

| Status                  | 29.35 | 33.01 | 27.77 |
|-------------------------|-------|-------|-------|
| Single/Never married    |       |       |       |
| Married/Cohabited       | 56.6  | 54.95 | 57.31 |
| Separated/Divorced/Widowed | 14.05 | 12.03 | 14.92 |

Presence of children

| Children            | 67.96 | 63.24 | 70.00 |
|---------------------|-------|-------|-------|
| No children         |       |       |       |
| Preschool children  | 13.23 | 16.69 | 11.73 |
| 0-4                 |       |       |       |
| Primary school      | 11.81 | 12.44 | 11.53 |
| children 5-11       |       |       |       |
| Middle school       | 7.01  | 7.63  | 6.74  |
| children 12-15      |       |       |       |

Employment status

| Status           | 33.17 | 30.22 | 34.45 |
|------------------|-------|-------|-------|
| Inactive         |       |       |       |
| Unemployed       | 4.55  | 5.67  | 4.06  |
| Working class    | 19.44 | 26.11 | 16.55 |
| Intermediate class | 14.69 | 14.97 | 14.57 |
| Service class    | 28.15 | 23.03 | 30.38 |

Number of people in household (1-16)

| In household (1-16) | 2.84 (1.39) | 2.90 (1.35) | 2.66 (1) |
|---------------------|-------------|-------------|----------|
| Logged household income (0-10.5) | 7.41 (0.68) | 7.36 (0.66) | 7.48 (0.58) |
| Portions of fruits/vegetables eaten per day (0-11) | 3.32 (1.57) | 3.05 (1.52) | 3.58 (1) |
| Drinking frequency the last year (1-8) | 4.68 (1.96) | 4.70 (1.95) | 4.42 (1) |

Health behaviors

| Behavior                    | 7.91  | 23.24 | 16.28 |
|-----------------------------|-------|-------|-------|
| Current smoker              |       |       |       |
| Ever smoked                 | 17.73 | 35.42 | 39.21 |
| Never smoked                | 74.36 | 41.34 | 44.51 |

Health limits moderate activities

| Moderate activities         | 18.39 | 9.96  | 7.02  |
|-----------------------------|-------|-------|-------|
| Yes, limited a lot          |       |       |       |
| Yes, limited a little       | 38.06 | 18.23 | 17.51 |
| No, not limited at all      | 43.55 | 71.81 | 75.47 |

Sporting frequency

| Frequency                  | 3.49 (2.92) | 3.11 (2.89) | 3.57 (2) |
|-----------------            |             |             |          |

Social support

| Support                  | 0.00 (0.99) | -0.12 (1.03) | 0.06 (C) |
|--------------------------|-------------|--------------|----------|
| Family support (-2.39-1.41) |             |              |          |
| Friend support (-2.41-1.09) |             |              |          |

Number of respondents

| Respondents    | 23,660 |
|----------------|--------|

Note. GHQ-12=12-Item General Health Questionnaire. SF-12 MCS=12-Item Short Form Health Survey Mental Component summary. Proportions reported for categorical variables. Mean values reported for continuous variables. Standard deviations in parenthesis.
Table 2. Fixed effects models predicting the associations between frequencies of art engagement & mental health

|                                          | GHQ-12 Mental Distress |          |          |
|-----------------------------------------|------------------------|----------|----------|
|                                          | Model 1 Coefficients (CI) | Model 2 Coefficients (CI) | Model 3 Coefficients (CI) |
| Participation in arts activities (ref=None) |                        |          |          |
| Once/twice per year                     | -0.35 (-0.80, 0.11)   | -0.33 (-0.78, 0.12) | -0.31          |
| Once per month                          | 0.07 (-0.29, 0.43)    | 0.04 (-0.32, 0.39)  | 0.05          |
| Once per week                           | -0.19 (-0.49, 0.11)   | -0.21 (-0.51, 0.10) | -0.21          |
| More than once per week                 | -0.31* (-0.60, -0.03) | -0.34* (-0.62, -0.05) | -0.29*        |
| Within R-squared                        | 0.00                   | 0.01     |          |

| Attendance at cultural events (ref=None) |                        |          |          |
| Once/twice per year                     | -0.13 (-0.40, 0.14)   | -0.14 (-0.41, 0.13) | -0.14          |
| Once per month                          | -0.18 (-0.46, 0.11)   | -0.18 (-0.46, 0.11) | -0.14          |
| More than once per week                 | -0.51** (-0.85, -0.16) | -0.50** (-0.85, -0.15) | -0.42*        |
| Within R-squared                        | 0.00                   | 0.01     |          |

SF-12 Mental Functioning

| Participation in arts activities (ref=None) |                        |          |          |
| Once/twice per year                     | 0.71 (-0.02, 1.45)     | 0.56 (-0.17, 1.29)  | 0.51          |
| Once per month                          | 0.13 (-0.47, 0.73)    | 0.11 (-0.49, 0.70)  | 0.08          |
| Once per week                           | 0.39 (-0.11, 0.90)    | 0.33 (-0.17, 0.83)  | 0.33          |
| More than once per week                 | 0.66** (0.21, 1.12)   | 0.57* (0.12, 1.02)  | 0.50*         |
| Within R-squared                        | 0.00                   | 0.02     | 0.03      |

| Attendance at cultural events (ref=None) |                        |          |          |
| Once/twice per year                     | 0.28 (-0.18, 0.74)     | 0.30 (-0.16, 0.76)  | 0.31          |
| Once per month                          | 0.25 (-0.23, 0.73)    | 0.22 (-0.26, 0.71)  | 0.18          |
| More than once per week or more         | 0.63* (0.05, 1.22)    | 0.56 (-0.03, 1.15)  | 0.49          |
| Within R-squared                        | 0.00                   | 0.02     | 0.03      |

Subjective wellbeing: Life satisfaction

| Participation in arts activities (ref=None) |                        |          |          |
| Once/twice per year                     | 0.14* (0.00, 0.28)     | 0.11 (-0.03, 0.25)  | 0.11          |
| Once per month                          | 0.08 (-0.02, 0.18)    | 0.06 (-0.04, 0.16)  | 0.06          |
| Once per week                           | 0.07 (-0.02, 0.16)    | 0.05 (-0.04, 0.14)  | 0.05          |
| More than once per week                 | 0.12** (0.04, 0.20)   | 0.10* (0.02, 0.18)  | 0.09*         |
| Within R-squared                        | 0.00                   | 0.02     | 0.03      |

| Attendance at cultural events (ref=None) |                        |          |          |
| Once/twice per year                     | 0.14*** (0.06, 0.22)   | 0.13** (0.05, 0.21)  | 0.13**        |
| Once per month                          | 0.14*** (0.06, 0.23)  | 0.12** (0.04, 0.21)  | 0.11*         |
| More than once per week or more         | 0.21*** (0.11, 0.32)  | 0.19*** (0.08, 0.29) | 0.17**        |
| Within R-squared                        | 0.00                   | 0.02     | 0.03      |

Note: Observations: 47,320. Respondents: 23,660. GHQ-12=12-Item General Health Questionnaire. SF-12 MCS=12-Item = automatically adjusted for time-constant variables. Model 2 additionally adjusted for demographic factors (age, age squared, marital status, presence of children, employment status, number of people in household, household income and wave). Model 3 additionally adjusted for health-related and social factors (extent to which health limits moderate activities, portions of fruits or vegetables eaten, drinking frequency, sporting frequency, family support and friend support). Confidence intervals in parentheses: p<0.05.
