BMJ Open

Association between attending cultural events and all-cause mortality: a longitudinal study with three measurements (1982–2017)

Lars Olov Bygren,[1,2] Filip Jansåker ,[3,4] Kristina Sundquist,[3] Sven-Erik Johansson[3]

To cite: Bygren LO, Jansåker F, Sundquist K, *et al*. Association between attending cultural events and all-cause mortality: a longitudinal study with three measurements (1982–2017). *BMJ Open* 2023;**13**:e065714. doi:10.1136/bmjopen-2022-065714

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-065714).

Received 17 June 2022
Accepted 10 February 2023

[1]Department of Biosciences and Nutrition, Karolinska Institutet, Stockholm, Sweden
[2]Community Medicine and Rehabilitation, Umeå University, Umeå, Sweden
[3]Center for Primary Health Care Research, Department of Clinical Sciences, Lund University, Malmö, Sweden
[4]Department of Clinical Microbiology, Rigshospitalet, Kobenhavn, Denmark

Correspondence to
Dr Filip Jansåker;
filip.jansaker@med.lu.se

ABSTRACT

Objectives To examine the association between cultural attendance and all-cause mortality.

Design A longitudinal cohort study over 36 years (1982–2017) with three 8-year interval measurements of exposure (1982/1983, 1990/1991 and 1998/1999) to cultural attendance and a follow-up period to 31 December 2017.

Setting Sweden.

Participants The study included 3311 randomly selected individuals from the Swedish population with complete data for all three measurements.

Primary outcome measurements All-cause mortality during the study period in relation to level of cultural attendance. Cox regression models with time-varying covariates were used to estimate HRs adjusted for potential confounders.

Results The HRs of cultural attendance in the lowest and middle levels compared with the highest level (reference; HR=1) were 1.63 (95% CI 1.34 to 2.00) and 1.25 (95% CI 1.03 to 1.51), respectively.

Conclusion Attending cultural events has a suggested gradient, the lesser cultural exposure the higher all-cause mortality during the follow-up.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A longitudinal study over 36 years with three measurements on cultural attendance and follow-up of all-cause mortality in a representative cohort of adults.
⇒ Several potential confounders were taken into account.
⇒ Most variables were self-reported, which risks self-report bias.

INTRODUCTION

We posited long ago that cultural attendance could be followed by a decreased mortality, and found in large population surveys of adult people in Sweden that attendance at fine arts events, such as films and concerts, was followed by a 41% decreased all-cause mortality.[1] About 10 609 individuals were interviewed at one time point, in 1982 and 1983, in the study. The outcome measure was survival until the end of 1996, that is, 13–14 years of follow-up. In total, 916 men and 600 women died during that period. We found a higher mortality risk for those people who rarely visited the cinema, concerts, museums or art exhibitions compared with those visiting them most often. The significant relative risks ranged between 1.14 (95% CI 1.01 to 1.31) of attending art exhibitions, and 1.42 (CI 1.25 to 1.60) of attending museums, and visits to the cinema and concerts in between. We could not discern any beneficial effect of attending the theatre, church service or sports event as a spectator or of reading or music making. The observations were indications that only certain kinds of cultural events had a beneficial effect on longevity.[1] During the following decades, studies examined all-cause mortality as an outcome with prospective designs and starting age ranges similar to ours, where a recent example was an 8-year follow-up study from Norway.[2] The authors followed 35 902 adults from a health survey and reported that non-participation in any receptive activity, except sport events attendance, had an all-cause risk reduction of 21% with two attendances in activities and 31% in three.[2] An English study of an ageing cohort of 6710 community dwelling adults, which started in 2004–2005, revealed that people who attended cultural activities on an infrequent basis (once or twice a year) still had 14% lower mortality compared with those who never attended cultural activities, independent of sex and socioeconomic factors. Additionally, those who attended cultural activities more frequently had a considerably (31%) lower risk of dying compared with those who never attended cultural activities.[3] Another study found that attending

sermons more than once weekly was inversely associated with 12-year mortality compared with never attending sermons.[4]

In this study, we adopted a much longer follow-up and covered the years 1982–2017 with three measurements every eighth year of exposure to cultural attendance. The aim was to analyse the longitudinal association between attending cultural events and all-cause mortality, adjusting for important confounders and/or effect modifiers, such as sex, age, education, marital status, social isolation, region of residence, long-term disease, tobacco smoking and physical exercise.

METHODS

Study design, population and setting

This was a longitudinal, observational study based on data from the Survey of Living Conditions[5] with three measurements every 8th year starting in 1982/1983: that is, (1) 1982/1983, (2) 1990/1991 and (3) 1998/99, including the longitudinal part in ages 20–67 years at baseline. Only participants with complete data for all three measurements (n=3311) were included in this study. These were followed until death (outcome), emigration or the end of the study period (31 December 2017), whichever came first. The STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) statement checklist for cohort studies was considered when conducting the study and writing the manuscript.[6] The study was conducted at the Centre for Primary Health Care Research, the Department of Clinical Sciences, Lund University, Sweden.

Ascertainment variables

Outcome

All-cause mortality after the last measurement with follow-up until 31 December 2017.

Exposure

Attending cultural events, that is, cultural attendance. This was defined as frequency of visiting (from never to every week or more often) cinemas, theatres, concerts, art museums, other museums and sermons. We included sermons in the cultural attendance index because religious activities, as important parts of people's culture, is recommended for inclusion by UNESCO[7] when measuring cultural participation. To define the level of cultural attendance at the three measurement periods, we calculated a cultural attendance index based on the factor scores from a principal component analysis (polychoric correlation coefficient for ordinal data). The results from this index were categorised separately for each of the three measurements into lowest (25%, quartile 1), middle (50%, quartiles 2–3) and highest (25%, quartile 4) level of cultural attendance. The highest level of cultural attendance was defined as the reference group. In the analyses, the participants with the lowest and middle level of cultural attendance were compared with the highest level.

Co-variates

- Sex: Categorised as male or female.
- Age: Categorised into 8-year groups (ie, 20–27, 28–35, 36–43, 44–51, 52–59, 60–67, 68–75 and 76–83 years of age at the three measurement points).
- Education: Educational level was self-reported and categorised as (1) low (≤9 years of school), (2) medium (10–12 years of school) and (3) high (≥13 years of school).
- Marital status: married/cohabiting versus single living.
- Socially isolated: Categorised by 'has no close friend' (socially isolated) versus has a close friend (not socially isolated).
- Region of residence: Large cities, middle-large cities and others.
- Long-term disease: Categorised as yes versus no based on the question: 'Do you have any chronic or long-term illness or long-term health problem?'
- Daily (tobacco) smoking: Categorised as yes versus no (including past use).
- Physical exercise: Based on indoor exercise and outdoor exercise and categorised as inactive/occasionally active or actively exercising at least once a week.

All variables were longitudinally collected at three measurement points and included as they may act as potential confounders. For example, as socioeconomic status is related to both the exposure (cultural events) and the outcome (mortality) it could act as a confounder.[8] We; therefore, adjusted for socioeconomic status in the analysis where education was used as a proxy for socioeconomic status.

Databases used

The database used to identify the study population was The Survey of Living Conditions (in Swedish: ULF)[5] obtained from the governmental authority on national statistics, Statistics Sweden (in Swedish: Statistikmyndigheten, SCB). Statistics Sweden randomly selects individuals from the Swedish population to participate in the ULF survey on an annual basis. The non-response rate was about 15% in 1982/1983 and increased to about 23% in 1998/1999. In this study, only participants who took part in all three measurements (1982/1983, 1990/1991 and 1998/1999) were included.[5] As the participants are the same at all three measurements, the differing non-response rates over time in the overall survey should not influence the results. The Total Population Register[9] (SCB, 1968–2018) was used to collect data on emigration. The Cause of Death Register[10] (Socialstyrelsen, 1961–2018) was used to collect data on mortality. Both these registers are of high quality and virtually complete for the entire national population.[9 10] All linkages between the population-based data were performed using a pseudonymised version of the unique 10-digit personal identification[11] number that

is assigned to each person for their lifetime on birth or immigration to Sweden.

Statistical method

Descriptive statistics on the study population are shown in table 1. Crude mortality rates (defined as number of deaths divided by person-years at risk), shown per 1000 person-years, were calculated for the main exposure and all covariates (table 2).

To assess the association between the main exposure and the outcome, conditional Cox regression models, with adjustment for time-varying covariates, were used to estimate HRs and 95% CIs. The study period started on 1 January 1982/1983, and person-years were calculated until an outcome event (all-cause mortality), emigration or end of the study period (31 December 2017). Three models were applied: model 1—crude model (only for attending cultural events, table 3); model 2—sex and age (in 8-year bands) adjusted model; model 3—fully adjusted model. Models 2 and 3 were conducted on all covariates (table 2). Table 3 shows a summary of HRs for the three models for cultural attendance.

To examine whether the strength of the associations did not change over time, proportionality assumptions were checked by plotting the incidence rates over time and by calculating Schoenfeld (partial) residuals. The assumptions of proportionality were satisfied except for age, which was included as a stratum (p=0.13) in the full model. In the sex-adjusted and age-adjusted models, age was included as a categorised variable (8-year groups).

We judged the fit from the full model by plotting the Nelson-Aalen cumulative hazard estimator for Cox-Snell residuals. There was some variability in the right-hand tail, residuals '>2', which was expected due to reduction of the effective sample caused by prior failures and censoring.

We also calculated unadjusted as well as sex-adjusted and age-adjusted incidence rates (or cumulative incidence based on last measurement) of cause of death categorised into three groups and survivors (online supplemental table 1). The 10th revision of the International Classification of Diseases (ICD-10) was used to stratify death causes into the three groups; that is, cancer (ICD-10 code 'C'), cardiovascular disease (ICD-10 code 'I' and all other causes of death).

When judging the interactions, the p value was adjusted by 0.05 divided by the number of comparisons. We found no meaningful interactions between attending cultural events and any of the covariates—such as sex, age, education, marital status, social isolation, region of residence, long-term disease, daily (tobacco) smoking and physical exercise.

STATA was used for the analysis. A two-tailed p<0.05 was defined as statistical significance.

Patient and public involvement statement

Due to the design, it was not possible to involve patients or the public in the design, conduct, reporting or dissemination plans of our research.

Table 1 Distribution (%) of the different variables by time of interview

Variables	1982/1983 (%)	1990/1991 (%)	1998/1999 (%)
No of participants (n)	3311	3311	3311
Sex			
Male	48.0	48.0	48.0
Female	52.0	52.0	52.0
Age (mean, years)	39.8	47.8	55.8
Age group (8-year bands)			
20–27	20.2	–	–
28–35	22.3	20.2	–
36–43	21.3	22.3	20.2
44–51	14.1	21.3	22.3
52–59	12.9	14.1	21.3
60–67	9.3	12.9	14.1
68–75	–	9.3	12.9
76–83	–	–	9.3
Education (years)			
≤9	68.6	64.0	62.9
10–12	22.3	24.3	25.0
>12	9.1	11.7	12.1
Marital status			
Married/cohabiting	73.4	77.6	73.1
Single living	26.6	22.4	26.9
Socially isolated			
Yes	25.3	27.8	35.5
No	74.7	72.2	64.5
Region of residence			
Large cities	31.4	31.1	30.4
Middle-sized towns	31.0	35.0	36.2
All others	37.6	33.9	33.4
Long-term diseases			
Yes	29.2	36.0	48.1
No	70.8	64.0	51.9
Daily (tobacco) smoking			
Yes	31.5	26.9	19.8
No (including past use)	68.5	73.1	80.2
Physical exercise			
Inactive/occasionally	58.6	65.1	66.0
At least once a week	41.4	34.9	34.0
Attending cultural events*			
Lowest (25%) (mean)	24.7	24.7	22.1
Middle (50%)	50.2	49.4	52.4
Highest (25%)	25.1	25.9	25.5

*Based on an index score from a principal component analysis (including the variables: visiting cinema, theatre, concert, art museum, other museums and sermons), the participants were approximately grouped into four quartiles (the intermediate quartiles were combined) at each measurement.

Table 2 The crude all-cause mortality rate (per 1000 person-years) and the HRs with 95% CI for the association between all-cause mortality and attending cultural events adjusted for all other variables

Covariates	Mortality rate (CI)	Sex-adjusted and age-adjusted HR* (CI)	Fully adjusted HR† (CI)
Education (years)			
≤9	11.2 (10.4 to 12.0)	1.54 (1.19 to 1.98)	1.11 (0.85 to 1.47)
10–12	5.5 (4.7 to 6.4)	1.25 (0.94 to 1.67)	1.16 (0.87 to 1.56)
>12	4.7 (3.6 to 6.1)	1 (reference)	1 (reference)
Marital status			
Married/cohabiting	7.2 (6.6 to 9.6)	1 (reference)	1 (reference)
Single living	14.6 (13.2 to 16.1)	1.47 (1.29 to 1.68)	1.48 (1.22 to 1.80)
Socially isolated			
Yes	14.6 (13.3 to 16.0)	1.27 (1.13 to 1.44)	0.90 (0.75 to 1.08)
No	6.6 (6.1 to 7.3)	1 (reference)	1 (reference)
Region of residence			
Large cities	8.0 (7.1 to 9.0)	1 (reference)	1 (reference)
Middle-sized towns	9.0 (8.1 to 10.0)	1.05 (0.90 to 1.22)	1.01 (0.86 to 1.18)
All others	9.9 (9.0 to 11.0)	1.22 (1.05 to 1.42)	1.11 (0.95 to 1.29)
Long-term diseases			
Yes	16.4 (15.2 to 17.7)	1.71 (1.50 to 1.96)	1.62 (1.41 to 1.85)
No	4.4 (3.9 to 4.9)	1 (reference)	1 (reference)
Daily (tobacco) smoking			
Yes	9.4 (8.8 to 10.1)	1.93 (1.66 to 2.24)	1.82 (1.56 to 2.12)
No (including past use)	7.8 (6.8 to 8.9)	1 (reference)	1 (reference)
Physical exercise			
Inactive/occasionally	11.8 (11.0 to 12.6)	1 (ref.)	1 (ref.)
At least once a week	4.4 (3.8 to 5.1)	0.58 (0.50 to 0.68)	0.68 (0.58 to 0.80)
Attending cultural events‡			
Lowest (25%)	16.2 (14.6 to 17.9)	2.06 (1.72 to 2.47)	1.63 (1.34 to 2.00)
Middle (50%)	7.9 (7.2 to 8.7)	1.42 (1.19 to 1.69)	1.25 (1.03 to 1.51)
Highest (25%)	5.3 (4.5 to 6.2)	1 (reference)	1 (reference)

*Adjusted for sex and age (in 8-year bands)
†Fully adjusted for all covariates, including age (in 8-year bands).
‡Based on factor scores from a principal component analysis (including the variables: visiting cinema, theatre, concert, art museum, other museums and sermons), the participants were approximately grouped into four quartiles (the intermediate quartiles were combined).

Table 3 The association between all-cause mortality and attending cultural events, HR with 95% CI

Attending cultural events*	Crude HR (CI)	Sex-adjusted and age-adjusted HR† (CI)	Fully adjusted HR‡ (CI)
Lowest (25%)	3.79 (3.14 to 4.57)	2.06 (1.72 to 2.47)	1.63 (1.34 to 2.00)
Middle (50%)	1.49 (1.24 to 1.79)	1.42 (1.19 to 1.69)	1.25 (1.03 to 1.51)
Highest (25%)	1 (reference)	1 (reference)	1 (reference)

*Based on factor scores from a principal component analysis (including the variables: visiting cinema, theatre, concert, art museum, other museums and sermon), the participants were approximately grouped into four quartiles (the intermediate quartiles were combined).
†Adjusted for sex and age (in 8-year groups).
‡Adjusted for all covariates (ie, sex; age in 8-year bands; education; marital status, socially isolated; region of residence; long-term disease; daily (tobacco) smoking and physical exercise).

RESULTS

Table 1 includes descriptive information of the 3311 participants (52% women). The mean age was 39.8 at baseline, ranging from 20 to 67 years. About two-thirds had 9 years of education or less at baseline. Marital status remained more or less stable through the measurement periods, while the percentage of participants living socially isolated increased between the measurement periods. The percentage participants with long-term diseases and low exercise level also grew larger by increasing age while the percentage of daily tobacco smokers decreased.

Table 2 describes the crude mortality rates and adjusted HRs for all-cause mortality associated with attending cultural events and all covariates during the follow-up period. The covariates were associated with all-cause mortality. In particular, single living, tobacco smoking and long-term diseases were strongly associated with mortality, which remained through the adjusted Cox analyses. Physical activity was inversely associated with all-cause mortality and participants who conducted physical exercise at least once a week had the lowest mortality risk during the study period: about 32% lower than the participants with low physical exercise activity.

The participants with the lowest level of attending cultural events had a more than threefold higher crude all-cause mortality rate than those with the highest level of cultural event attendance. The associations remained significant in all models (table 3) but weakened when adjusting for potential confounders. For example, in the fully adjusted model 3, the HRs of all-cause mortality were 1.63 (95% CI 1.34 to 2.00) and 1.25 (95% CI 1.03 to 1.51) for the participants with lowest and middle levels of attending cultural events, respectively, compared with the participants with the highest level.

In online supplemental table S1, the cumulative incidence of survivors at the last measurement was highest in the group with the highest level of attending cultural events. Furthermore, all three cause of death categories (ie, cardiovascular disease, cancer and all other causes) were over-represented in the low level of cultural attendance. A statistical significance in the examination of the association between the unadjusted cumulative incidence and attending cultural events was also observed (p=0.0001).

DISCUSSION

We studied cultural attendance during leisure time by including only those with three measurements with 8-year intervals from 1982/1983 to 1998/1999. In the period after, until the end of 2017, the association between cultural attendance and all-cause mortality suggested a dose–response relationship in this random sample of Swedish adults aged 20–67 years at the study start: that is, the HRs for low and middle levels of cultural attendance were larger than in those with the highest level of attending cultural events (HR=1), resulting in HRs of 1.63 (95% CI 1.34 to 2.00) and 1.25 (95% CI 1.03 to 1.51), respectively, adjusting for possible confounders. To our knowledge, this 36-year follow-up study of cultural attendance and all-cause mortality of adults is the first study with such a long follow-up period.

The association between cultural attendance and health has been a subject in many fields of science. In philosophy, the most extensive and most basic is the last work of John Dewey, which dealt with the experience of art. After his previous work had become a basis in educational systems, the American philosopher's last contribution gave a hint on the mechanism for the effect in humans. He examined the experience of art not only as an 'erfarung' but stressed its meaning of 'erlebung' which in German is a term for an overwhelming feeling.[12] Having this experience at a young age could easily leave marks that even transfer to further generations.[13] In psychology, evidence has accumulated that leisure can contribute to a strengthening of physical, social, emotional and cognitive health through adjustments even to traumas.[14] Evidence also shows that psychological distress is strongly associated with mortality in humans.[15–17] Basic biology has contributed with a line of research called 'environmental enrichment'. An enriched environment for laboratory mice typically includes a larger cage, toys for play, a running wheel for physical activity and company of others. Compared with controls in ordinary cages, these mice have better memory and learning, enhanced synaptic density and neurogenesis, a delay in animal models of Alzheimer's and Parkinson's diseases, and an effect on proteins, such as brain derived neurotrophic factor. The enriching may induce demethylations in the hippocampus and frontal cortex, which is important for memory, and in the hypothalamic–hypophysial–adrenal axis, which is important for mood and depression.[13] The mechanisms in the association between higher cultural attendance and longer life expectancy may therefore lie in basic biological processes, as found in animal and human responses to both adverse and enriched environments.[13] These processes might be explained by epigenetics,[18 19] where environmental factors related to severe chronic diseases (eg, cardiovascular diseases and type 2 diabetes) are capable of influencing epigenetic mechanisms.[19–22] However, further studies are needed to clarify the underlying biological mechanisms. As expected, adjusting for age and sex attenuated the results, where men have a higher mortality than women.[23] In addition, leisure time can contribute to psychological well-being,[14] where men seem to be more vulnerable to the effect of psychological distress on mortality.[16]

These findings need to be considered in light of the limitations. First, most variables were self-reported, which risks self-report bias. Second, as all the major cause of death categories were over-represented in the low level of cultural attendance, reverse causation (ie, that participants with poorer health are less able to attend cultural events) could be a culprit to our findings. However, we adjusted for long-term disease; daily tobacco smoking; and physical exercise, making the risk of reverse causation

less plausible. Third, although we had access to important risk factors for increased mortality (eg, daily tobacco smoking, physical exercise, long-term disease) we cannot fully rule out the possibility of residual confounding due to, for example, drug use and alcohol consumption.[24 25] Finally, we were unable to determine the optimal level of cultural attendance, which types of cultural events that have the most beneficial effect or what is an ideal mix of events to attend. These aspects represent research gaps that could be examined further in future studies. Nevertheless, we believe the strengths balances out the limitations. First, this is a longitudinal study with three measurement points on a randomly selected portion of the Swedish adult population.[5] Second, the study included a large number of adjustment variables and followed the participants for a very long period of time (36 years). Finally, the findings of a graded association between cultural attendance and mortality, that were in-line with previous findings based on shorter follow-up periods,[1–4 26] together with the general coherence with findings from animal data,[13 27] provides some support for a causal interpretation of the results in this longitudinal study. Together with the previous evidence, these findings suggest that accessibility to cultural activities in the society might be of importance for longevity and that the associations with cultural attendance were not strongly confounded by socioeconomic status (education).

In conclusion, cultural attendance seems to be a strong preventive force in humans according to this mortality-and-art analysis, which is in line with previous studies. Embracing pastimes[28] for the adult population might be a safety valve for frustrations of everyday life where cultural events could decrease all-cause mortality.

Acknowledgements We thank Patrick O'Reilly for language edits.

Contributors All authors have approved the final version of the manuscript. Concept and visualisation: S-EJ, LOB and KS. Development of idea and design: all authors. Access and acquisition of data: KS. Analysis and statistics: S-EJ. Tables: S-EJ and FJ. Interpretation of data: all authors. Literature search and drafting of manuscript: LOB, S-EJ and FJ. Critical revision of the manuscript for intellectual content: KS, LOB and S-EJ. The authors attest that all listed authors meet the authorship criteria and that no others meeting the criteria have been omitted. KS and S-EJ are the authors responsible for the overall content as the guarantor.

Funding FJ was supported by governmental funding (Alf funding; 2022–0071) of clinical research within the Swedish Public Healthcare, Region Skåne (Sweden) during the period.

Disclaimer The funding sources of the study were all non-commercial and the funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study was approved by the Ethical Review Board in Lund, Sweden.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. This study made use of national registers and, owing to legal concerns, data cannot be made openly available. Further information regarding the registries is available from the Swedish National Board of Health and Welfare (https://www.socialstyrelsen.se/en/statistics-and-data/registers/ and from Statistics Sweden (https://www.scb.se/en/ and https://www.scb.se/en/finding-statistics/statistics-by-subject-area/living-conditions/living-conditions/living-conditions-surveys-ulfsilc/).

ORCID iD

Filip Jansåker http://orcid.org/0000-0003-0670-9996

REFERENCES

1 Bygren LO, Konlaan BB, Johansson SE. Attendance at cultural events, reading books or periodicals, and making music or singing in a choir as determinants for survival: Swedish interview survey of living conditions. *BMJ* 1996;313:1577–80.
2 Løkken BI, Merom D, Sund ER, *et al*. Cultural participation and all-cause mortality, with possible gender differences: an 8-year follow-up in the HUNT study, Norway. *J Epidemiol Community Health* 2020;74:624–30.
3 Fancourt D, Steptoe A. The art of life and death: 14 year follow-up analyses of associations between arts engagement and mortality in the English longitudinal study of ageing. *BMJ* 2019;367:l6377.
4 Lutgendorf SK, Russell D, Ullrich P, *et al*. Religious participation, interleukin-6, and mortality in older adults. *Health Psychol* 2004;23:465–75.
5 SCB. *Statistics sweden (in swedish: statistikmyndigheten). statistics on income and living conditions (in sweidsh: undersökningarna av levnadsförhållanden [ULF]). LE0101 (5120)*. Sweden, 2021. Available: http://www.scb.se/le0101
6 von Elm E, Altman DG, Egger M, *et al*. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet* 2007;370:1453–7.
7 Morrone A. *Guidelines for measuring cultural participation*. UNESCO Institute for Statistics © UNESCO-UIS. UIS/TD/06-02. ISBN: 978-92-9189-059-0, 2006. Available: http://www.uis.unesco.org/
8 Mak HW, Coulter R, Fancourt D. Patterns of social inequality in arts and cultural participation: findings from a nationally representative sample of adults living in the United Kingdom of great britain and Northern Ireland. *Public Health Panor* 2020;6:55–68.
9 Ludvigsson JF, Almqvist C, Bonamy A-KE, *et al*. Registers of the Swedish total population and their use in medical research. *Eur J Epidemiol* 2016;31:125–36.
10 Brooke HL, Talbäck M, Hörnblad J, *et al*. The Swedish cause of death register. *Eur J Epidemiol* 2017;32:765–73.
11 Ludvigsson JF, Otterblad-Olausson P, Pettersson BU, *et al*. The Swedish personal identity number: possibilities and pitfalls in healthcare and medical research. *Eur J Epidemiol* 2009;24:659–67.
12 Dewey J. *Art as experience*. New York: Capricorn Books, 1958.
13 Bygren LO. Intergenerational health responses to adverse and enriched environments. *Annu Rev Public Health* 2013;34:49–60.
14 Caldwell LL. Leisure and health: why is leisure therapeutic? *British Journal of Guidance & Counselling* 2005;33:7–26.
15 Ponizovsky AM, Haklai Z, Goldberger N. Association between psychological distress and mortality: the case of Israel. *J Epidemiol Community Health* 2018;72:726–32.
16 Puustinen PJ, Koponen H, Kautiainen H, *et al*. Psychological distress measured by the GHQ-12 and mortality: a prospective population-based study. *Scand J Public Health* 2011;39:577–81.
17 Russ TC, Stamatakis E, Hamer M, *et al*. Association between psychological distress and mortality: individual participant pooled analysis of 10 prospective cohort studies. *BMJ* 2012;345:e4933.

18 Lorenzen JM, Martino F, Thum T. Epigenetic modifications in cardiovascular disease. *Basic Res Cardiol* 2012;107:245.
19 Schiano C, Benincasa G, Franzese M, *et al*. Epigenetic-sensitive pathways in personalized therapy of major cardiovascular diseases. *Pharmacol Ther* 2020;210:107514.
20 Si J, Yang S, Sun D, *et al*. Epigenome-Wide analysis of DNA methylation and coronary heart disease: a nested case-control study. *Elife* 2021;10:e68671.
21 Chambers JC, Loh M, Lehne B, *et al*. Epigenome-Wide association of DNA methylation markers in peripheral blood from Indian Asians and Europeans with incident type 2 diabetes: a nested case-control study. *Lancet Diabetes Endocrinol* 2015;3:526–34.
22 Handy DE, Castro R, Loscalzo J. Epigenetic modifications: basic mechanisms and role in cardiovascular disease. *Circulation* 2011;123:2145–56.
23 Rosella LC, Calzavara A, Frank JW, *et al*. Narrowing mortality gap between men and women over two decades: a registry-based study in ontario, canada. *BMJ Open* 2016;6:e012564.
24 Liu Y-T, Lee JH, Tsai MK, *et al*. The effects of modest drinking on life expectancy and mortality risks: a population-based cohort study. *Sci Rep* 2022;12:7476.
25 Mack KA, Jones CM, Ballesteros MF. Illicit drug use, illicit drug use disorders, and drug overdose deaths in metropolitan and nonmetropolitan areas-United States. *MMWR Surveill Summ* 2017;66:1–12.
26 Väänänen A, Murray M, Koskinen A, *et al*. Engagement in cultural activities and cause-specific mortality: prospective cohort study. *Prev Med* 2009;49:142–7.
27 Schrijver NCA, Pallier PN, Brown VJ, *et al*. Double dissociation of social and environmental stimulation on spatial learning and reversal learning in rats. *Behav Brain Res* 2004;152:307–14.
28 Konlaan BB, Theobald H, Bygren LO. Leisure time activity as a determinant of survival: a 26-year follow-up of a Swedish cohort. *Public Health* 2002;116:227–30.