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REVIEW

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A systematic review of longitudinal risk factors for loneliness in older adults

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ABSTRACT

Objectives: To effectively reduce loneliness in older adults, interventions should be based on firm evidence regarding risk factors for loneliness in that population. This systematic review aimed to identify, appraise and synthesise longitudinal studies of risk factors for loneliness in older adults.

Methods: Searches were performed in June 2018 in PsycINFO, Scopus, Sociology Collection and Web of Science. Inclusion criteria were: population of older adults ($M = 60+$ years at outcome); longitudinal design; study conducted in an OECD country; article published in English in a peer-review journal. Article relevance and quality assessments were made by at least two independent reviewers.

Results: The search found 967 unique articles, of which 34 met relevance and quality criteria. The Netherlands and the United States together contributed 19 articles; 17 analysed national samples while 7 studies provided the data for 19 articles. One of two validated scales was used to measure loneliness in 24 articles, although 10 used a single item. A total of 120 unique risk factors for loneliness were examined. Risk factors with relatively consistent associations with loneliness were: not being married/partnered and partner loss; a limited social network; a low level of social activity; poor self-perceived health; and depression/depressed mood and an increase in depression.

Conclusion: Despite the range of factors examined in the reviewed articles, strong evidence for a longitudinal association with loneliness was found for relatively few, while there were surprising omissions from the factors investigated. Future research should explore longitudinal risk factors for emotional and social loneliness.

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KEYWORDS
Loneliness; predictor; older people; longitudinal; risk factor

Loneliness in old age has adverse consequences for well-being, physical and mental health, and mortality (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Leigh-Hunt et al., 2017; Rico-Uribe et al., 2018). While many studies have examined correlates of loneliness, fewer have explored risk factors for loneliness prospectively. An understanding of such risk factors is crucial for the development and implementation of effective interventions to alleviate loneliness, and longitudinal studies offer better evidence than cross-sectional studies for causal mechanisms due to the temporal relationship between predictor and outcome. This article reports the findings of a systematic review of longitudinal risk factors for loneliness in older adults.

A common definition of loneliness states that loneliness is 'a discrepancy between one's desired and achieved levels of social relations' (Perlman & Peplau, 1981, p. 32). This discrepancy may concern the number of relationships, frequency of contact, or the intimacy or quality of the relationships. Sometimes, definitions of loneliness specify two dimensions: emotional and social, where emotional loneliness refers to the absence of a close emotional attachment, while social loneliness refers to the absence of an engaging social network (Weiss, 1973).

There have been several reviews of loneliness in older adults. Some systematic reviews and meta-analyses have focused on consequences of loneliness in people of all ages or in adults, for example in terms of health and mortality (for an overview of reviews, see Leigh-Hunt et al., 2017), while a scoping review has summarised studies on loneliness and health in older adults (Courtin & Knapp, 2017). Other reviews have focused on interventions to reduce loneliness in older adults (for overviews of reviews, see Fakoya, McCorry, & Donnelly, 2020; Victor et al., 2018).

There have also been reviews examining risk factors for loneliness, although these have mainly included cross-sectional studies. For example, Pinquart and Sörensen (2001, 2003) undertook meta-analyses of risk factors for loneliness in older adults based on cross-sectional studies. Routasalo and Pitkala (2003) noted in their review of risk factors for loneliness that only a few studies of older adults were of longitudinal design. A recent review including both cross-sectional and longitudinal studies (Cohen-Mansfield, Hazan, Lerman, & Shalom, 2016) concluded that most associations between risk factors and loneliness had been examined in cross-sectional studies.

Although there is a growing body of longitudinal research on loneliness, to date no systematic review has summarised the evidence-base on longitudinal risk factors for loneliness in older adults. This article aims to identify, appraise and summarise available longitudinal research on risk factors for loneliness in older adults.

Methods

The reporting of this systematic review mostly follows the Preferred Reporting Items of Systematic Reviews and Meta-

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analyses (PRISMA) guidelines, although these were not developed for reviews of risk factors (Liberati et al., 2009; Moher, Liberati, Tetzlaff, Altman, & The Prisma Group, 2009). A review protocol has been registered at the international prospective register of systematic review (PROSPERO; 2018 CRD42018091159).

Inclusion criteria

The following inclusion criteria were applied:

- Population: older adults, defined as an average age of 60 years or older among participants at point of outcome measurement
- Exposure: any risk factor for loneliness
- Outcome: loneliness
- Study design: quantitative longitudinal
- Setting: Organisation for Economic Co-operation and Development (OECD) country
- Publication type: peer-review journal articles
- Publication language: English
- Time period: no restriction

Search strategy for identification of studies

The search strategy was developed with support from a librarian. The literature search was conducted on 25 June 2018 and included studies published up to this date. The search covered the following databases: PsycINFO, Scopus, Sociology Collection and Web of Science. The search combined four groups of keywords: 1) loneliness, 2) older adults, 3) longitudinal design, and 4) risk factor (see Supplement A for an example). Additional relevant articles were identified via, e.g. reference lists of included articles and previous reviews.

Selection of studies

Article relevance was assessed using a checklist based on the inclusion criteria presented above. Titles and abstracts of articles identified via the database search were examined independently by two of the authors (A.F., M.N.) and obviously irrelevant articles were removed. For the remaining articles, a full-text relevance assessment was made independently by two authors (A.F., M.N.). Disagreements were resolved via discussion with one or both of the other authors (L.D., K.J.M.). Reasons for exclusion of articles at this stage were recorded (see Supplement B) and double-checked for accuracy (L.D.).

Quality assessment (risk of bias)

Most quality criteria for systematic reviews are developed for the assessment of intervention studies and are not necessarily appropriate for other study designs. For the purpose of this review, the authors were guided in the development of their own quality criteria by those proposed by others (Boyle, 1998; SBU, 2014). The criteria used related to aspects of sampling, measurement, and analysis. For further details, see Supplement C.

Two authors (A.F., M.N.) independently quality assessed each relevant article. The assessments based on individual criteria were discussed with the other two authors (L.D., K.J.M.) who agreed an overall assessment for each article. Studies assessed as being of low quality were not included in the synthesis of results in this review.

Data extraction and analysis

Data were extracted from the articles by one of the authors (L.D.) and double-checked for accuracy by a research assistant (E.A.) (see Table 1). When articles failed to provide clear methodological information on e.g. recruitment, response rate or attrition rate, where possible such information was determined by two authors together (L.D., K.J.M.) based on details available in the article, or in separate technical reports.

Findings from the articles were summarised in a narrative synthesis. All predictive bivariate and/or multivariable associations between a risk factor and global loneliness reported in an article are listed in Table 2 and indicated to be: significant and positive (high levels of the factor predict high levels of loneliness); significant and negative (high levels of the factor predict low levels of loneliness); or non-significant. A small number of articles considered risk factors for recovery from loneliness, but we have not reported their findings. Where an article presented associations for emotional and social loneliness but not global loneliness, we report a single association if they were consistent; if they differed in significance or direction, we specify this and report the separate associations. Most articles used $p<.05$ as the level of significance for a statistical test, and this is the level used in this review. Associations of $p \geq .05$ are therefore reported as non-significant even if described as significant in the article.

The associations obtained from baseline to follow-up are reported. For articles with multiple data collection waves where more than one longitudinal association was analysed, a single result is reported where associations across waves were consistent or where the form of analysis provided only one association. Where there was variation in the association across different waves, these findings are reported separately. Baseline and follow-up(s) are standardised across studies regardless of the time interval between waves and indicated as: T0 (baseline); T1 (first follow-up); T2 (second follow-up), etc. If in an article there were several multivariable models analysing associations between (sub)sets of risk factors and loneliness, the associations in the final/full model have been reported. Where an article addressed a subgroup of the population, this is specified.

We do not report: variables included in articles but for which the longitudinal association with loneliness was not reported; moderator effects; and associations between loneliness at baseline and loneliness at follow-up(s) – the latter, when presented, were always statistically significant and positive.

In several cases conceptually similar risk factors were operationalised and labelled in divergent ways across articles. Where in the consensual judgement of two of the authors (L.D., K.J.M.) differently labelled factors were effectively operationalisations of the same construct, variations in labelling were standardised and the findings for those risk factors are listed together under a single label. The

Table 1. Characteristics of included articles.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
Aartsen & Jylhä, 2011 Medium	To investigate the impact of baseline levels of a wide range of social and personal resources, and losses in these resources, on the onset of loneliness in older age. Also, to investigate to what extent gender differences can be explained in terms of a differential exposure to risk factors across men and women.	Tampere Longitudinal Study on Aging (TamELSA) 1979; 1989; 1999; 2006 Single item: Do you feel lonely? (often; sometimes; never; don't know)	Tampere, Finland Sample: 60–89 years Subsample: Not lonely at baseline Age: $M = 66.2$ ($SD = 5.6$) Female gender: 53.3%	Face-to-face interviews in 1979, 1989, 1999; telephone interviews in 2006 Random selection from population register, stratified by gender and 5-year birth cohorts Response rate: 82% Attrition rates from wave 1: 3.5%; 57.5%; 93.5% $N = 469$
Ayalon et al., 2016 Medium	Focused on the association of memory functioning and loneliness in an attempt to identify its temporal order.	The Health and Retirement Study (HRS) 2004; 2008; 2012 Scale: 3-item revised version of the UCLA Loneliness Scale	United States Sample: 50+ years. According to Fisher and Ryan (2018), including spouses of any age and excluding institutionalised individuals Age: $M = 65.6$ (SE 9.02) Female gender: 59.8%	Self-administrated questionnaire, and face-to-face or telephone interviews Sampling method not stated. According to Fisher and Ryan (2018), multi-stage, national area-clustered probability sample frame of households, with oversampling of Black and Hispanic populations and Florida residents Response rate: approx. 70% Attrition: Not stated $N = 1225$ (data for loneliness and memory functioning in 2004 and at least one additional measurement point, i.e. 2008, 2012)
Brittain et al., 2017 Medium	To explore the extent to which people aged 85 years are lonely and how loneliness changes between age 85 and 88, as well as the associated risk factors.	The Newcastle 85+ Study 2006, follow-up after 18 and 36 months Single item: Wording not stated (always; often; sometimes; never)	Newcastle, England Sample: 85 years at baseline. Registered with a participating general practice in Newcastle or North Tyneside National Health Service Primary Care Trust Age: 85 years Female gender: 61.3%	Multidimensional health assessment Total population included Response rate: Not stated; calculation based on flow-chart 58.0% Attrition: Not stated. Calculations based on available figures: 21.3%, 21.5% $N = 750$; 590; 463 (data available for study variables)
Böger & Huxhold, 2018 Medium	To investigate how the interrelationship between loneliness and social integration and that between loneliness and physical health changes as people move from middle adulthood into old age. Also, to investigate the extent to which a person's level of negative affect may serve as age-differentiated mediator on the pathway that leads from loneliness to impaired physical health.	German Ageing Survey 1996; 2002; 2008; 2011 Scale: 6-item de Jong-Gierveld Scale	Germany Sample: 40–84 years living in the community Age: $M = 59.1$ ($SD = 11.9$) Female gender: 49.1%	In-home interviews and self-administrated questionnaires National probability sampling, stratified by gender, place of residence and age group Response rate: Not stated. According to Klaus et al. (2017), 50.3% Attrition: Not stated. According to Klaus et al. (2017), 31.5%; 20.5%; 21.5% $N = 11{,}010$ (one valid measure for each of the constructs of interest)
Cacioppo et al., 2010 Medium	To determine the relationship between loneliness and depressive symptoms in a sample of individuals born between 1935 and 1952.	Chicago Health, Aging, and Social Relations Study (CHASRS) (2002/2003; 2003/2004); 2004/2005; 2005/2006; 2006/2007 [Wave 3 onwards is included in this review, as Wave 4 is the first wave with 60+ age group] Scale: 20-item UCLA Loneliness Scale-Revised	Cook County, Illinois, United States Sample: English-speaking; born 1935–1952; non-Hispanic White, African American or non-Black Latino American persons; sufficiently ambulatory to come to the University and participate in the study According to Cacioppo et al., 2017, age at wave 3: $M = 59.4$ ($SD = 4.3$) Female gender at wave 3: 54.7%	Psychological and demographic surveys, health and medication interviews, anthropometric measurements, and a cardiovascular protocol Multistage probability design: a) identifying a subset of households estimated to have high probability of containing at least one adult aged 50–65 years. A stratified, equal-probability of selection sample drawn from this subset. Strata: (1) households from census tracts in which at least 80 percent of the residents were African American, (2) households for which the associated surname was identified

(*continued*)

Table 1. Continued.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
				by the U.S. Census Department as 'Hispanic', and (3) all remaining households. b) Selecting one age-eligible individual per household, and screening to include only those who belonged to one of the three racial/ethnic groups of interest and were sufficiently ambulatory to come to the University and participate in the study. Quota sampling strategy used at both the household and individual levels to achieve an approximately equal distribution of participants across the six gender by racial/ethnic group combinations Response rate: approached 45% overall Attrition: On average 7.2% annually (year 1–5) $N = 192$ (Wave 3); 178; 163; 140; 127; 117; 116; 113
Cacioppo et al., 2017 Medium to low	Our goal in this study was to contrast four competing hypotheses: Hypothesis 1: Loneliness prospectively predicts self-centeredness but self-centeredness does not prospectively predict loneliness. Hypothesis 2: Loneliness does not prospectively predict self-centeredness but self-centeredness prospectively predicts loneliness. Hypothesis 3: Loneliness and self-centeredness may prospectively predict one another. Null Hypothesis: There is no lagged association between loneliness and self-centeredness.	Chicago Health, Aging, and Social Relations Study (CHASRS) (2002/2003; 2003/2004); 2004/2005; 2005/2006; 2006/2007; 2008/2009; 2009/2010; 2010/2011; 2011/2012; 2012/2013 [Wave 3 onwards is included in this review, as Wave 4 is the first wave with 60+ age group] Scale: 20-item Revised UCLA Loneliness Scale	Cook County, Illinois, United States Sample: English-speaking; born 1935–1952; sufficiently ambulatory to come to the University of Chicago for an annual, daylong visit; non-Hispanic White, Blacks/African American or Hispanic. Age at wave 3: $M = 59.4$ ($SD = 4.3$) Female gender at wave 3: 54.7%	Survey questionnaire, demographic and psychological surveys, health and medication interviews, anthropometric measurements, physiological assessments, and blood draws. Multistage probability sampling design; oversampling of minorities to ensure approximately equal sample sizes across ethnicities Response rate: Not stated. According to Cacioppo et al. (2010), 45% Attrition: Not stated. According to Cacioppo et al. (2010), on average 7.2% annually (year 1–5) $N = 192$ (Wave 3); 178; 163; 140; 127; 117; 116; 113
Cohen-Mansfield et al., 2009 Medium	To examine whether loneliness increases with age; characteristics of the lonely older population; and predictors of becoming lonely in old age.	The Cross-Sectional and Longitudinal Aging Study (CALAS) 1989/1992; 1993/1994 Single item: from the 20-item Center for Epidemiologic Studies Depression Scale (CES-D): frequency at which participants had felt lonely during the last month (no; sometimes; most of the time; almost every day)	Israel Sample: Jews 75+ years Subsample: Self-respondent. Non-institutionalised at baseline For total baseline sample ($N = 1147$) Age: $M = 83.1$ ($SD = 5.32$) Female gender: 44.9%	In-home questionnaire-based interviews. Proxy interviews. Random selection from Israeli National Population Register stratified by age groups, gender and place of birth (Europe/America, Middle East/North Africa, Israel) Response rate: 75.8% Attrition: Not stated, calculations based on available figures: 47.2% $N = 588$ (with data on loneliness for both waves)
Dahlberg et al., 2015 Medium	To examine the extent to which older women and men (70+) report feelings of loneliness with a focus on changes in reported loneliness as people age, and which factors predict loneliness.	Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD) 2004; 2011 Single item: Are you ever bothered by feelings of loneliness? (nearly always; often; seldom; almost never)	Sweden Sample: 70+ years Age: $M = 76.7$ ($SD = 5.23$) Female gender: 61.8%	Telephone interviews in 2004. Primarily face-to-face interviews in 2014 (21.0% telephone interviews). Also proxy interviews (4.8% in 2004; 11.1% in 2011). 1 in 1000 of population. According to Lennartsson et al. (2014), random sample Response rate: 87.3% Attrition: Not stated. Calculations based on available figures: 42.9% $N = 587$ (with data on loneliness for both waves)

(*continued*)

Table 1. Continued.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
Dahlberg et al., 2018 Medium	The aim of this study was to examine whether there is an association between loneliness in old age and social engagement 20 years earlier.	Swedish Level of Living Survey (LNU) and Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD) 1981/1991 (pooled); 2002/2011 (pooled) Single item: Are you ever bothered by feelings of loneliness? (nearly always; often; seldom; almost never)	Sweden Sample: Not stated. Calculations based on available figures: 56+ years Age: $M = 62.2$ Female gender: 59.0%	Structured interviews, primarily face-to-face, also via telephone. 1 in 1000 of population. According to Lennartsson et al. (2014), random sample Response rate: 76.1% in 1981 and 72.7% in 1991 Attrition: Not stated $N = 823$ (with data on loneliness for both waves)
Deckx et al., 2015 Medium	To study the frequency and evolution of social and emotional loneliness in older cancer patients in comparison with younger cancer patients and older people without cancer, and to evaluate if changes in common cancer-related and ageing-related problems such as fatigue, cognitive functioning and functional status contributed to the occurrence of loneliness.	The KLIMOP study (Dutch acronym for project on older cancer patients in Belgium and Netherlands) Until August 2012, 1-year follow-up Scale: 11-item de Jong-Gierveld Loneliness Scale	Belgium and Netherlands Sample: 50+ year old patients with new diagnosis of breast or coleorectal cancer, and older people without cancer Age: Not stated Female gender: Not stated, calculations based on available figures: 75.4%	Personal interviews or self-administered questionnaires Cancer patients recruited through 7 hospitals in Belgium and Netherlands. Older people without cancer recruited through general practices and home nurses in the same regions. Exclusion of non-Dutch speakers, dementia diagnosis, and estimated life expectancy of < 6 months Response rate: Not stated Attrition: Not stated. Calculations based on available figures: 38.5% $N = 422$
Donovan et al., 2017 Medium	To examine the reciprocal relations of loneliness and cognitive function in older adults, adjusting for social network, depression and other demographic and health-related factors	Health and Retirement Study (HRS) 1998; 2000; 2002; 2004; 2006; 2008; 2010 Single item from Center for Epidemiologic Studies Depression Scale (CES-D), 8-item version, whether symptom 'felt lonely' was present or absent 'much of the time during the past week' (present, not present).	United States Sample: 50+ years living in households. According to Fisher and Ryan (2018), including spouses of any age Subsample: Non-Hispanic White and Black participants, age 65+ in 2000 Age $M = 73.2$ ($SD = 6.47$) Female gender: 60%	Cognitive and clinical assessments Probability sample. According to Fisher and Ryan (2018), multi-stage, national area-clustered probability sample frame of households, with oversampling of Black and Hispanic populations and Florida residents Response rate: Not stated Attrition: Not stated $N = 8382$
Dykstra et al., 2005 High	To examine loneliness and its correlates – health, residential care, partner status, and network size – over a seven-year period among adults born between 1908 and 1937.	Living Arrangements and Social Networks of Older Adults (NESTOR-LSN); Longitudinal Aging Study Amsterdam (LASA) 1992; 1992/1993; 1995/1996; 1998/1999 Scale: 11-item de Jong-Gierveld Loneliness Scale	Geographical setting not stated. According to Huisman et al. (2011), three regions in Netherlands Sample: Born 1908–1937 For participants with data on all four waves ($N = 1701$): Age: $M = 66.9$ ($SD = 8.1$) Female gender: 54.6%	Face-to-face interviews Stratified random sample with overrepresentation of the oldest individuals, in particular the oldest men. According to Huisman et al. (2011) and Knipsher, de Jong Gierveld, van Tilburg, and Dykstra (1995), sample recruited from 11 municipal registries in three regions $N = 2925$ (data for at least two waves) Response rate: 62% Calculations based on figures in Huisman et al. (2011): 18.3%, 18.1%, 18.4%
Gum et al., 2017 Medium	To gather evidence about the potential impacts that hopelessness and loneliness have on each other over time, using longitudinal data from the US HRS and controlling for several covariates of both constructs, including depressive symptoms and medical conditions.	Health and Retirement Study (HRS) 2006; 2010; 2014 Scale: 3-item Revised UCLA Loneliness Scale	United States Sample: 50+ years and their spouses of any age. According to Fisher and Ryan (2018), excluding institutionalised individuals $M = 66.0$ (SE 0.21) Female gender: 54.7%	Self-administered questionnaire Sampling method not stated. Over-representation of Blacks, Hispanics, and residents of the State of Florida. According to Fisher and Ryan (2018), multi-stage, national area-clustered probability sample frame of households Response rate: Not stated Attrition: Not stated. $N = 7831$

(*continued*)

Table 1. Continued.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
Hawkley & Kocherginsky, 2018 Medium	To examine protective and risk factors for changes in loneliness.	National Social Life, Health an Aging project (NSHAP) 2005/2006; 2010/2011 Scale: 3-item UCLA Loneliness Scale	United States Sample: Community residing adults born between 1920 and 1947 Age: $M = 67.1$ ($SD = 7.2$) Female gender: 52.2%	Interview, leave behind questionnaire Complex, multistage area probability sample with poststratification; oversampling of Blacks, non-Black Hispanics, and the oldest old. According to O'Muircheartaigh, English, Pedlow, and Kwok (2014), based on national household screening carried out by HRS 2004 and 2010 cohorts. Response rate: Not stated. According to O'Muircheartaigh et al. (2014): 75.5% Attrition: Not stated, calculation based on available figures: 24.8% $N = 2261$
Hoogendijk, Suanet, Dent, Deeg, & Aartsen, 2016 Medium	To examine the association between physical frailty and social functioning among older adults, both cross-sectionally and prospectively over 3 years. Social functioning included network size, instrumental and emotional support received, and loneliness, which cover both structural and functional aspects of social networks.	Longitudinal Aging Study Amsterdam (LASA) 2005/2006; 2008/2009 Scale: 11-item de Jong-Gierveld Loneliness Scale	Netherlands Sample: 55–85 years Subsample: People aged 65 years or older $M = 74.0$ ($SD = 6.6$) Female gender: 54.2%	In-home face-to-face main interview, separate medical interview including medical tests Sampling method not stated. According to Huisman et al. (2011) and Knipsher et al. (1995), stratified random sample recruited from 11 municipal registries in three regions, with overrepresentation of the oldest individuals, in particular older men. Response rate: Not stated. Calculations based on available figures: 80.6% Attrition: Not stated. Calculation based on available figures: 23.2% $N = 856$
Houtjes et al., 2014 Medium to low	To investigate whether the course of late-life depression impacts network size and perceived loneliness, taking into account gender and age of the respondents involved.	Longitudinal Aging Study Amsterdam (LASA) 1992/1993; 1995/1996; 1998/1999; 2001/2002; 2005/2006 Scale: 11-item de Jong-Gierveld Loneliness Scale	Netherlands Sample: >55 years Subsample: Scoring ≥ 16 on Center for Epidemiological Studies Depression Scale (CES-D) Age: $M = 71.8$ ($SD = 8.8$) Female gender: 65%	Interviews Sampling method not stated. Stratified for sex, age and level of urbanicity, with oversampling of oldest old and men. According to Huisman et al. (2011) and Knipsher et al. (1995), sample recruited from 11 municipal registries in three regions. Response rate: Not stated. According to Huisman et al. (2011), 85% for total sample. Attrition: Not stated. Calculations based on available figures: 38.2% $N = 277$ (CES-D data on at least two follow-ups)
Margelisch et al., 2017 Medium	To identify groups of long-term married persons with respect to marital satisfaction and to compare them longitudinally concerning their well-being outcomes, marital stressors, personality and socio-demographic variables.	Study not stated. Sample provided by Federal Office of Statistics 2012; 2014 Scale: 6-item de Jong Gierveld Loneliness Scale	Switzerland Sample: People aged 40–90 years Subsample: Continuously married individuals aged 60–89 and married for 40+ years. Age: $M = 74.3$ ($SD = 7.4$) Female gender: Not stated. Calculations based on available figures: 49.7%	Survey Random sample stratified by age, gender and marital status. Response rate: Not stated Attrition: 33% $N = 252$
Moreh et al., 2010 Medium	To evaluate the association of fatigue with health, functional status, and mortality from ages 70–88 years.	Jerusalem Longitudinal Cohort Study 1990/1991; 1997/1998; 2005/2006 Loneliness measure: Not stated (often or occasionally; never)	Jerusalem, Israel Sample: Jerusalem residents born 1920–1921 Subsample: Not lonely at baseline.	Medical and social interviews; medical assessment, system review, and examination Randomly recruited participants from electoral registry, i.e. complete register of Jerusalem residents born 1920–1921.

(*continued*)

Table 1. Continued.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
			Age: 70 years Female gender: Not stated. Calculations based on available figures: 45.7%	Response rate: Not stated. Calculations based on available figures: 79.7% Attrition: Not stated/unclear. N = Not stated. Calculations based on available figures: $N = 178$ for 70- to 78-year olds; $N = 341$ for 78- to 85-year olds
Newall et al., 2009 Medium	To examine older individuals' causal beliefs about affiliation as immediate and long-term predictors of loneliness.	Aging in Manitoba (Canada) Study 1996; 2001 Scale: de Jong-Gierveld 11-item loneliness scale.	Manitoba, Canada Sample: Manitobans aged 65 years or older Subsample: Community-dwelling Age: $M = 78.9$ ($SD = 4.68$) Female gender: Not stated ($M = 1.59$, $SD = .49$, with men = 1, women = 2)	Face-to-face interviews Random selection of community-dwelling 65+ in Manitoba, stratified by place of residence (community vs. personal care home) and region. Response rate: Not stated Attrition: Not stated. Calculations based on available figures: 35.8% $N = 688$
Nicolaisen & Thorsen, 2012 Medium	To examine the extent to which socio-demographic factors, health status and mastery influence loneliness in older adults without impairments and older adults with impairments.	Norwegian Life Course, Ageing and Generation Study (NorLAG) 2002/2003; 2007/2008 Single item: Do you feel lonely? (often; sometimes; seldom; never)	30 municipalities and townships, Norway Sample: People aged 40–79 years living outside institutions Subsample: 67–79 years Age: $M = 71.9$ ($SD = 3.4$) for people without impairments, $M = 73.2$ ($SD = 3.7$) for people with impairments Female gender: 46% for people without impairments, 72% for people with impairments	Public registries, telephone interviews and postal questionnaires. Sampling method not stated. According to Lappegård and Veenstra (2010), random sample stratified by age, gender, geographical region and centrality of residential municipality Response rate: 67% for telephone interview, of which 75% returned postal questionnaire, i.e. 50.2%. According to Lappegård and Veenstra (2010), 60.0% and 72.5%, respectively. Attrition: 28.4% $N = 699$
Nicolaisen & Thorsen, 2014 Medium to low	The primary aim of this study is to explore how early and later life events during the life course influence the experience of loneliness for men and women in different age groups.	Norwegian study of the life course, ageing and generations (NorLAG) 2002/2003; 2007/2008 Single item: Do you feel lonely? (often; sometimes; seldom; never)	30 municipalities and townships, drawn from four regions, Norway Sample: People aged 40–80 years not living in institutions For this review, analyses selected for people aged 60–80 years Age: Not stated Female gender: 51%. For older group: Not stated; Calculations based on available figures: 50.6%	Public records, telephone interviews and postal questionnaires. Sample stratified by age and gender. According to Lappegård and Veenstra (2010), random sample, stratified by age, gender, geographical region and centrality of residential municipality Response rate: 67% for telephone interview, of which 75% returned postal questionnaire, i.e. 50.2%. According to Lappegård and Veenstra (2010), 60.0% and 72.5%, respectively. Attrition: 28.4% $N = 1352$
Pikhartova et al., 2016 Medium to low	To determine if those, who think that old age is time of loneliness and expect that, as they get older, they will become more lonely, report higher rates of loneliness than those who do not support these views.	English Longitudinal Study of Ageing (ELSA) 2004; 2006; 2008; 2010; 2012 Scale: 3-item UCLA Loneliness Scale	England Sample: 50+ years. Living in private address. Subsample: Not lonely at baseline Age: $M = 64.1$ Female gender: Not stated. Calculations based on available figures: 52.2%	Data collection method not stated. According to Steptoe, Breeze, Banks, and Nazroo (2013), computer-assisted personal interviews and self-completion questionnaires. Drawn from Health Survey for England. According to Steptoe et al. (2013), drawn from 1998, 1999 and 2000 waves of the Health Survey for England (HSE), where at least one person in HSE household must have agreed to follow-up Response rate: Not stated. According to Steptoe et al. (2013), 82% Attrition: Not stated $N = 4465$

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Table 1. Continued.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
Pronk et al., 2011 Medium	To determine the possible longitudinal relationships between hearing status and depression, and hearing status and loneliness in the older population.	Longitudinal Aging Study Amsterdam (LASA) 2001/2002; 2005/2006 Scale: 11-item de Jong-Gierveld Loneliness Scale	Netherlands Sample: 55–85 years Subsamples: Hearing status based on self-report (SR) and speech-in-noise (SNT) Age: $M = 76.4$ ($SD = 8.0$) in SR sample, 73.4 ($SD = 6.5$) in SNT sample Female gender: 57% in SR sample, 56% in SNT sample	Interviews, test Random sample, stratified for age and gender. According to Huisman et al. (2011) and Knipsher et al. (1995), sample recruited from 11 municipal registries in three regions, with overrepresentation of the oldest individuals, in particular older men. Response rate: Not stated. Attrition: Not stated. Calculations based on available figures: 27.6% $N = 996$ for SR-sample; $N = 830$ for SNT-sample
Pronk et al., 2014 Medium	To investigate whether there is an association between the rate of hearing decline and the rate of decrease in psychosocial health (i.e. loneliness and depression) in a population-based sample of older adults; and to investigate whether baseline hearing status, sociodemographic characteristics, and health-related characteristics (age, gender, level of education, level of income, partner status, hearing aid use, comorbid conditions, vision problems, and cognition) moderate this association.	Longitudinal Aging Study Amsterdam (LASA) 2001/2002; 2005/06; 2008/09 Scale: 11-item de Jong-Gierveld Loneliness Scale	Netherlands Sample: 55–85 years Age: median = 72.4 for T_1T_2 sample; 67.8 for T_2T_3 sample Female gender: Not stated (value given for multilevel model including repeated measurement of some individuals, so not valid)	In-home measurements Random sample, stratified for age and gender. According to Huisman et al. (2011) and Knipsher et al. (1995), sample recruited from 11 municipal registries in three regions, with overrepresentation of the oldest individuals, in particular older men. Response rate: Not stated. Attrition: Not stated. Calculation based on available figures: 48.2% $N = 1178$
Rius-Ottenheim et al., 2012 Medium	To investigate the relationship between dispositional optimism and the presence of feelings of loneliness in older men.	Zutphen Elderly Study 1990; 1993; 1995; 2000 Scale: 11-item de Jong Gierveld Loneliness Scale	Zutphen, Netherlands Sample: Older male inhabitants of Zutphen Age: $M = 74.9$ ($SD = 4.7$) Female gender: 0%	Face-to-face interviews Sampling method not stated Response rate: 78.0% Attrition: Not stated $N = 416$
Rouxel et al., 2017 Medium	To examine the cross-sectional and longitudinal associations between oral health-related quality of life (OHRQoL) and loneliness amongst older adults living in England. Also, to examine the contribution of socio-demographic and socio-economic factors, health, smoking, and psychosocial factors in explaining the aforementioned association, and assess if the combination of edentulousness with poor OHRQoL increased the risk of loneliness.	English Longitudinal Study of Ageing (ELSA) 2006/2007; 2010/2011 Scale: 3-item UCLA Loneliness Scale	England Sample: 50+ years. Living in private household. Age: Not stated. Female gender: Not stated. Calculations based on available figures: 52.4%	Face-to-face Computer Assisted Personal Interview (CAPI) and self-completion questionnaires Drawn from Health Survey of England (HSE). According to Steptoe et al. (2013), drawn from 1998, 1999 and 2000 waves of the Health Survey of England (HSE), where at least one person in HSE household must have agreed to follow-up Response rate: Not stated. According to Steptoe et al. (2013), 73% Attrition: Not stated $N = 4640$
Sutin et al., 2015 Medium	To examine whether discrimination based on eight personal characteristics shares similar or different associations with health outcomes; to test the effect of discrimination on three domains of health – physical, emotional, and cognitive – to examine whether different forms of	Health and Retirement Study (HRS) 2006; 2010 Scale: 3-item UCLA Loneliness Scale	United States Sample: 50+ years. According to Fisher and Ryan (2018), including spouses of any age and excluding institutionalised individuals Age: $M = 67.5$ ($SD = 10.6$) Female gender: 58.8%	Psychosocial questionnaire completed at home Sampling method not stated. According to Fisher and Ryan (2018), multi-stage, national area-clustered probability sample frame of households, with oversampling of Black and Hispanic populations and Florida residents $N = 5507$

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Table 1. Continued.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
	discrimination have differential associations with these aspects of health; and to test the longitudinal association between discrimination and change in physical, emotional, and cognitive health across four years to examine whether discrimination is associated with changes in health over time.			Response rate: Not stated Attrition: Not stated
Taekema et al., 2010 Medium	To assess if handgrip strength predicts changes in functional, psychological and social health among oldest old.	Leiden 85-plus Study Enrolment 1997–1999; annual follow-ups. Scale: 11-item de Jong Gierveld Loneliness Scale	Leiden, Netherlands Sample: All inhabitants who reached 85 years, including nursing home residents. Age: 85 (M, *SD* = not stated) Female gender: 65.0%	Recordings at home visits, performance tests, blood sample, electrocardiogram, medical history via general practitioner or nursing home physician Total sample *N* = 555 Response rate: 87% Attrition: Not stated. Calculations based on available figures: 7.3%
Taube et al., 2013 Medium to low	To investigate the prevalence and predictors of loneliness in older people (aged 78+) over a six year period.	Swedish National Study on Aging and Care (SNAC-B) 2001/2003; 2004/2006; 2007/2009 Single item: Do you ever feel lonely? (never; seldom; sometimes; often)	One municipality in the region of Blekinge, Sweden Sample: People aged 60–96 years Subsample: Aged 78 years or older Age: *M* = 84.2 (*SD* = 4.68) Female gender: 59.4%	Structural interviews, medical examinations, supplementary questionnaires Sampling method not stated. Response rate: 61% for total sample Attrition: Not stated. Calculations based on available figures: 33.5%, 38.0% *N* = 511; 317
Tijhuis et al., 1999 Medium	To analyse to what extent feelings of loneliness are related to age, cohort effects or time trends, and to investigate the relationship between loneliness and changes in situational factors like institutionalization, health and partner status.	Zutphen Elderly Study 1985; 1990; 1995 Scale: 11-item de Jong Gierveld Loneliness Scale	Zutphen, Netherlands Sample: Men born between 1900 and 1920 living in Zutphen Age: *M* = 72.6 (*SD* = 5.4) Female gender: 0%	Questionnaire Random selection Response rate: 74% Attrition: Not stated. Calculations based on available figures: 40.4%, 38.7% *N* = 343
van Baarsen, 2002 Medium	To focus on the role of self-esteem and social support in adjustment to loneliness experienced by bereaved elderly persons, and to examine the contributions of a general and a specific coping theory toward explaining loneliness. A distinction has been made between emotional loneliness and social loneliness/ perceived support.	Widowhood Adaptation Longitudinal Study (WALS) Year of baseline and follow-up(s): Not stated, 5 follow-ups with 6- to 7-month interval Scale: 11-item de Jong Gierveld Loneliness Scale	11 municipalities, Netherlands Sample: People aged 55–89 years Subsample: Those who had lost their partner in previous 7 months Age: *M* = 73 (*SD* = 8.4) Female gender: Not stated. Calculation based on available figures: 61.3%	Interviews Sampled from the Living Arrangements and Social Networks of Older Adults (NESTOR). According to Huisman et al. (2011) and Knipsher et al. (1995), stratified random sample recruited from 11 municipal registries in three regions in Netherlands, with overrepresentation of the oldest individuals, in particular older men. Response rate: 62% Attrition: Not stated. Calculation based on available figures: 21.1% across the study period *N* = 111
Warner & Adams, 2016 High	To (1) test the stress deterioration hypothesis by examining whether changes in older adults' social resources mediate the association between functional limitations and changes in loneliness; (2) to test the stress buffering	National Social Life, Health, and Aging Project (NSHAP) 2005/2006; 2010/2011 Scale: 3-item UCLA Loneliness Scale	United States Sample: Community-dwelling people aged 57–85 years Subsample: Married/partnered at both waves	Interviews, leave behind questionnaire Sampling method not stated. According to O'Muircheartaigh et al. (2014), multi-stage area probability sample design, with oversampling of areas with high density of Blacks and Latinos, based on national household screening carried out by HRS 2004 and 2010 cohorts.

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Table 1. Continued.

Reference Overall quality of study	Aim(s)	Study Year of baseline and follow-up(s) Loneliness measure	Geographical setting Sample Subsample for analyses Subsample participant characteristics: age and gender at baseline (unless otherwise stated)	Data collection method Sampling method Response rate Attrition (loss to each wave) Analytic sample size
	hypothesis by assessing whether changes in social resources moderate the association between functional limitations and changes in loneliness, where positive social relations may buffer physical disability and negative social relations may exacerbate physical disability; and (3) to evaluate the extent to which the associations identified between functional limitations, changes in social relations, and changes in loneliness differ for married men and women.		Age: $M = 65.9$ (SE 0.28) Female gender: 44%	Response rate: 84% for leave behind questionnaire. For interviews not stated. According to O'Muircheartaigh et al. (2014), 75.5% for total sample. Attrition: 24.8% $N = 914$
Wong & Waite, 2017 Medium	To test the theory that elder mistreatment leads to declines in health, and that social support buffers its ill effects.	National Social Life, Health, and Aging Project (NSHAP) 2005/2006; 2010/2011 Scale: NSHAP Felt Loneliness Measures, constructed using 3-item UCLA Loneliness Scale	United States Sample: Aged 57–85 According to O'Muircheartaigh et al. (2014), household-resident. Age at follow-up: $M = 73$ Female gender at follow-up: 52.1%	Interviewer-administered in-home questionnaire, in-home biomeasure collection procedure, a self-administered post-interview/leave-behind questionnaire Multiple-stage probability sampling to randomly select individuals, complex sampling design balancing age and gender but oversampling Blacks and Hispanics. According to O'Muircheartaigh et al. (2014), based on national household screening carried out by HRS 2004 and 2010 cohorts. Response rate: 75.5% Attrition: Not stated. Calculations based on available figures: 24.8% $N = 2261$
Yang, 2018 Medium	To reveal the patterns of longitudinal loneliness; to test the longitudinal stability of loneliness; and to discover whether the risk factors identified in cross-sectional studies remain statistically significant longitudinally.	English Longitudinal Study of Ageing (ELSA) 2004/2005; 2006/2007; 2008/2009; 2010/2011; 2012/2013 Note: Data seems to be pooled. Scale: 3-item UCLA Loneliness Scale	England Sample: 50+ years. According to Steptoe et al. (2013), living in private households. $M = 66.4$ ($SD = 10.26$) Female gender: 55.5%	Data collection method not stated. According to Steptoe et al. (2013), computer-assisted personal interviews and self-completion questionnaires. Sampling method not stated. According to Steptoe et al. (2013), drawn from 1998, 1999 and 2000 waves of the Health Survey of England (HSE), where at least one person in HSE household must have agreed to follow-up Response rate: Not stated. According to Steptoe et al. (2013), 82% Attrition: 20%–40% Sample size: Not stated.

Table 2. Results of risk factors for loneliness.

Risk factor	Bivariate longitudinal association		Multivariable longitudinal association	
Demographic factors ($n = 3$)				
1. Age	+	Dahlberg et al., 2015; Newall et al., 2009; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016	+	Donovan et al., 2017; Dykstra et al., 2005; age squared: Sutin et al., 2015; at T2: Taube et al., 2013
	n.s.	Aartsen & Jylhä, 2011; Cohen-Mansfield et al., 2009	n.s.	Aartsen & Jylhä, 2011; Cacioppo et al., 2017; Dahlberg et al., 2015; Deckx et al., 2015; Hawkley & Kocherginsky, 2018; in married people: Margelisch et al., 2017; Newall et al., 2009; Nicolaisen & Thorsen, 2012, 2014; Sutin et al., 2015; at T1: Taube et al., 2013; in men: Tijhuis et al., 1999; Warner & Adams, 2016
2. Gender (female)	+	Aartsen & Jylhä, 2011; Cohen-Mansfield et al., 2009; Dahlberg et al., 2015; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016	+	Cohen-Mansfield et al., 2009; Donovan et al., 2017
			−	Dykstra et al., 2005; in married people, for emotional loneliness at T2: van Baarsen, 2002
	n.s.	Newall et al., 2009	n.s.	Aartsen & Jylhä, 2011; Brittain et al., 2017; Cacioppo et al., 2017; Dahlberg et al., 2015; Deckx et al., 2015; Hawkley & Kocherginsky, 2018; in married people: Margelisch et al., 2017; Newall et al., 2009; Nicolaisen & Thorsen, 2012, 2014; Taube et al., 2013; in widows/widowers, for emotional loneliness, T1, T3, for social loneliness all waves: van Baarsen, 2002; Warner & Adams, 2016; Yang, 2018
Gender (direction of coding not specified)			+	Sutin et al., 2015
3. Ethnicity (ref. White)			n.s.	Hawkley & Kocherginsky, 2018; Sutin et al., 2015
Hispanic			−	Warner & Adams, 2016
			n.s.	Cacioppo et al., 2017
Black			−	Cacioppo et al., 2017
			n.s.	Donovan et al., 2017; Warner & Adams, 2016
Other			n.s.	Warner & Adams, 2016
Socio-economic factors ($n = 7$)				
1. Household income (ref. High)	−	Pikhartova et al., 2016	n.s.	Cacioppo et al., 2017; Warner & Adams, 2016
Medium to high			+	Donovan et al., 2017
Medium			n.s.	Donovan et al., 2017
Medium to low			n.s.	Donovan et al., 2017
Low			+	Donovan et al., 2017
2. Income-to-needs ratio			n.s.	Hawkley & Kocherginsky, 2018
Financial situation				
3. Not having enough money	+	Cohen-Mansfield et al., 2009	+	Cohen-Mansfield et al., 2009
			n.s.	in married people: Margelisch et al., 2017
4. Household assets/wealth			−	Donovan et al., 2017
			n.s.	Hawkley & Kocherginsky, 2018
5. Education	−	Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016	−	Donovan et al., 2017; Sutin et al., 2015
	n.s.	Cohen-Mansfield et al., 2009; Dahlberg et al., 2015; Newall et al., 2009	n.s.	Cacioppo et al., 2017; Dahlberg et al., 2015; Deckx et al., 2015; Hawkley & Kocherginsky, 2018; Newall et al., 2009; Nicolaisen & Thorsen, 2012, 2014; Warner & Adams, 2016
6. Social status	−	Pikhartova et al., 2016		
7. Employment status				
Employed	−	Pikhartova et al., 2016		
			n.s.	Hawkley & Kocherginsky, 2018
Social factors ($n = 58$)				
1. Marital/partner status				

(*continued*)

Table 2. Continued.

Risk factor	Bivariate longitudinal association		Multivariable longitudinal association	
Married/partnered	−	Cohen-Mansfield et al., 2009; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016	−	Deckx et al., 2015; Dykstra et al., 2005; in people without impairments: Nicolaisen & Thorsen, 2012; Pikhartova et al., 2016; in men: Tijhuis et al., 1999
	n.s.	Aartsen & Jylhä, 2011; Dahlberg et al., 2018	n.s.	Cohen-Mansfield et al., 2009; Dahlberg et al., 2018; Hawkley & Kocherginsky, 2018; in individuals with impairments: Nicolaisen & Thorsen, 2012; Nicolaisen & Thorsen, 2014; Taube et al., 2013
Widowed	+	Dahlberg et al., 2015	+	Dahlberg et al., 2015
2. No. of times previously married			n.s.	Warner & Adams, 2016
3. Length of widowhood (ref. Not widowed)				
1–2 years			n.s.	Brittain et al., 2017
3–4 years			n.s.	Brittain et al., 2017
>5 years			−	Brittain et al., 2017
4. Age when widowed			−	in widows/widowers, for social loneliness at T3: van Baarsen, 2002
			n.s.	in widows/widowers for emotional loneliness all follow-ups, for social loneliness at T1, T2: van Baarsen, 2002
Marital/partner status change			n.s.	Yang, 2018
Becoming widowed	+	Dahlberg et al., 2015	+	Dahlberg et al., 2015; Nicolaisen & Thorsen, 2014
Partner loss, unspecified	+	Aartsen & Jylhä, 2011	+	Aartsen & Jylhä, 2011; Dykstra et al., 2005; in men: Tijhuis et al., 1999
New partner			n.s.	Dykstra et al., 2005
Living arrangement				
5. Living alone	+	Newall et al., 2009	+	Brittain et al., 2017; Newall et al., 2009; at T1: Taube et al., 2013
			n.s.	Hawkley & Kocherginsky, 2018; at T2: Taube et al., 2013
6. Household size	−	Pikhartova et al., 2016		
7. In residential care			+	Brittain et al., 2017; in men: Tijhuis et al., 1999
			n.s.	Dykstra et al., 2005
Living arrangement change				
Entered residential care			+	in men: Tijhuis et al., 1999
			n.s.	Dykstra et al., 2005
Social contacts				
8. Social contacts	−	Dahlberg et al., 2015		
	n.s.	Dahlberg et al., 2018	n.s.	Dahlberg et al., 2018; Dahlberg et al., 2015
9. Social network			−	Böger & Huxhold, 2018; Donovan et al., 2017; Dykstra et al., 2005
			n.s.	Cacioppo et al., 2010; Hawkley & Kocherginsky, 2018
10. Proportion of kin in network			n.s.	Hawkley & Kocherginsky, 2018
11. Number of close relationships	−	Pikhartova et al., 2016		
12. Number of friends			n.s.	Hawkley & Kocherginsky, 2018
13. Having sufficient number of friends			n.s.	Taube et al., 2013
14. Having close friends	n.s.	Aartsen & Jylhä, 2011		
15. Number of close family members			n.s.	Hawkley & Kocherginsky, 2018
16. Socialising frequently			n.s.	Hawkley & Kocherginsky, 2018
Social contact change				
Social contact reduction	n.s.	Dahlberg et al., 2015	n.s.	Dahlberg et al., 2015
Social network reduction			+	Dykstra et al., 2005
Loss of close friends	+	Aartsen & Jylhä, 2011	n.s.	Aartsen & Jylhä, 2011
Close friends (number)			n.s.	Yang, 2018
Close family members (number)			n.s.	Yang, 2018
17. Close children* (number)			n.s.	Yang, 2018
Relationship quality				
18. Positive marital quality/marital satisfaction	−	in married people: Margelisch et al., 2017	−	in married people, for social loneliness: Margelisch et al., 2017; Warner & Adams, 2016
			n.s.	in married people, for emotional loneliness: Margelisch et al., 2017

(*continued*)

Table 2. Continued.

Risk factor	Bivariate longitudinal association		Multivariable longitudinal association	
19. Closeness of non-spousal relationships			n.s.	Hawkley & Kocherginsky, 2018
20. Negative marital quality/marital strain			n.s.	in married people: Margelisch et al., 2017; Warner & Adams, 2016
21. Family strain			n.s.	Hawkley & Kocherginsky, 2018
22. Verbal abuse by family			+	Wong & Waite, 2017
23. Financial abuse by family			n.s.	Wong & Waite, 2017
24. Family and friendship strain			n.s.	Warner & Adams, 2016
25. Friendship strain			+	Hawkley & Kocherginsky, 2018
26. Verbal abuse by non-family			n.s.	Wong & Waite, 2017
27. Financial abuse by non-family			n.s.	Wong & Waite, 2017
Relationship quality change				
Reduced closeness to partner			+	Yang, 2018
Positive marital quality			−	Warner & Adams, 2016
Negative marital quality			n.s.	Warner & Adams, 2016
Family and friendship strain			n.s.	Warner & Adams, 2016
Social support				
28. Social support			−	Cacioppo et al., 2010
29. Marital support			n.s.	Wong & Waite, 2017
30. Marital support prior to widowhood			−	in widows/widowers, for social loneliness at T3: van Baarsen, 2002
			n.s.	in widows/widowers, for emotional loneliness at all follow-ups, for social loneliness at T1, T2: van Baarsen, 2002
31. Family support			−	Hawkley & Kocherginsky, 2018; Wong & Waite, 2017
32. Friendship support			n.s.	Hawkley & Kocherginsky, 2018; Wong & Waite, 2017
33. Family and friendship support			n.s.	Warner & Adams, 2016
34. Network support			n.s.	in widows/widowers: van Baarsen, 2002
35. Having a best female friend			n.s.	in widows/widowers: van Baarsen, 2002
36. Having a best male friend			+	in widows/widowers, for social loneliness at T3: van Baarsen, 2002
			n.s.	in widows/widowers, for emotional loneliness at all follow-ups, for social loneliness at T2: van Baarsen, 2002
37. Emotional support	−	Dahlberg et al., 2018	−	Dahlberg et al., 2018
	n.s.	Cohen-Mansfield et al., 2009		
Social support change				
Family and friendship support			n.s.	Warner & Adams, 2016
Value of social support and contact				
38. Perceived need of support			+	for widows/widowers, for emotional loneliness: van Baarsen, 2002
			n.s.	for widows/widowers, for social loneliness: van Baarsen, 2002
39. Importance of family contact			−	for widows/widowers, for emotional loneliness at T2: van Baarsen, 2002
			n.s.	for widows/widowers, for emotional loneliness at T3, for social loneliness at T2, T3: van Baarsen, 2002
40. Importance of non-family contact			+	for widows/widowers, for emotional loneliness at T2: van Baarsen, 2002
			n.s.	for widows/widowers, for emotional loneliness at T3, for social loneliness at T2, T3: van Baarsen, 2002
Social activity				
41. Social activity	−	Newall et al., 2009	−	Böger & Huxhold, 2018; Dahlberg et al., 2018; Newall et al., 2009
	n.s.	Aartsen & Jylhä, 2011; Dahlberg et al., 2018		
42. Membership in organisations and active in neighbourhood	−	Pikhartova et al., 2016		
43. Attendance at group meetings			n.s.	Hawkley & Kocherginsky, 2018
44. Attendance at religious services	n.s.	Dahlberg et al., 2018	n.s.	Hawkley & Kocherginsky, 2018
45. Spending last Passover with close friends/relatives	n.s.	Cohen-Mansfield et al., 2009		

(*continued*)

Table 2. Continued.

Risk factor	Bivariate longitudinal association		Multivariable longitudinal association	
Social activity change				
Reduced social activity	+	Aartsen & Jylhä, 2011	+	Aartsen & Jylhä, 2011
Life events				
46. Traumatic	n.s.	Cohen-Mansfield et al., 2009		
47. Significant			n.s.	Cacioppo et al., 2010
Childhood				
48. Conflict between parents	+	Nicolaisen & Thorsen, 2014		
49. Being bullied	+	Nicolaisen & Thorsen, 2014		
50. Economic problems in the home	+	Nicolaisen & Thorsen, 2014		
Discrimination				
51. Age			+	Sutin et al., 2015
52. Weight			+	Sutin et al., 2015
53. Physical disability			+	Sutin et al., 2015
54. Physical appearance			+	Sutin et al., 2015
55. Race			n.s.	Sutin et al., 2015
56. Ancestry			n.s.	Sutin et al., 2015
57. Sex			n.s.	Sutin et al., 2015
58. Sexual orientation			n.s.	Sutin et al., 2015
Health-related factors ($n = 23$)				
Self-perceived health				
1. Self-perceived health	−	Cohen-Mansfield et al., 2009; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016	−	Dykstra et al., 2005; in men: Tijhuis et al., 1999; in widows/widowers at T2, T3: van Baarsen, 2002
	n.s.	Aartsen & Jylhä, 2011	n.s.	Brittain et al., 2017; Cohen-Mansfield et al., 2009; Nicolaisen & Thorsen, 2012; in widows/widowers at T1: van Baarsen, 2002
2. Self-perceived physical health			n.s.	Hawkley & Kocherginsky, 2018
3. Self-perceived health compared to other people the same age	−	Newall et al., 2009		
Self-perceived health change				
Improved self-perceived health			−	Dykstra et al., 2005
			n.s.	Nicolaisen & Thorsen, 2014; Yang, 2018
Reduction	n.s.	Aartsen & Jylhä, 2011		
(ref. Healthy at all times)				
Improvement			n.s.	in men: Tijhuis et al., 1999
Reduction			+	in men: Tijhuis et al., 1999
Less healthy at all times			+	in men: Tijhuis et al., 1999
4. Partner's health			n.s.	in married people: Margelisch et al., 2017
Health conditions				
5. Health conditions	+	Newall et al., 2009		
			n.s.	Böger & Huxhold, 2018; Donovan et al., 2017
6. Health status			−	Newall et al., 2009
7. Limiting long-standing illness			n.s.	Brittain et al., 2017
8. Co-morbidity	+	Cohen-Mansfield et al., 2009		
			n.s.	Cohen-Mansfield et al., 2009
9. Leg pain			+	at T1: Taube et al., 2013
			n.s.	at T2: Taube et al., 2013
10. Cancer stage			n.s.	Deckx et al., 2015
Health conditions change				
Limiting long-standing illness			n.s.	Yang, 2018
11. Health-related quality of life			n.s.	Taube et al., 2013
Health-related quality of life change				
12. Reduction in at least one area of quality of life due to oral health problems*			+	Rouxel et al., 2017

(*continued*)

Table 2. Continued.

Risk factor	Bivariate longitudinal association		Multivariable longitudinal association	
Cognitive functioning				
13. Cognitive functioning			n.s.	Donovan et al., 2017; Taube et al., 2013; in men: Tijhuis et al., 1999
14. Memory functioning	−	Ayalon et al., 2016	−	Ayalon et al., 2016
Change in cognitive functioning				
(ref. Not impaired)				
Was impaired			n.s.	Deckx et al., 2015
Became impaired			+	Deckx et al., 2015
Persistently impaired			+	Deckx et al., 2015
15. Frailty				
(ref. Not frail)				
Pre-frail			n.s.	Hoogendijk et al., 2016
Frail			+	Hoogendijk et al., 2016
Functional limitation				
16. Activities of daily living (ADL) limitations			+	Hawkley & Kocherginsky, 2018; Warner & Adams, 2016
17. Instrumental activities of daily living (IADL) limitations	+	Newall et al., 2009		
	n.s.	Cohen-Mansfield et al., 2009	n.s.	Newall et al., 2009
18. ADL and IADL limitations			+	Dykstra et al., 2005
	n.s.	Aartsen & Jylhä, 2011	n.s.	Deckx et al., 2015; Taube et al., 2013; in men: Tijhuis et al., 1999
(ref. No limitations)				
Low ADL and IADL limitations			+	Brittain et al., 2017
Medium ADL and IADL limitations			n.s.	Brittain et al., 2017
High ADL and IADL limitations			n.s.	Brittain et al., 2017
19. Mobility problems	+	Dahlberg et al., 2015		
			n.s.	Dahlberg et al., 2015
Functional limitation change				
Increase in ADL and IADL limitations	+	Aartsen & Jylhä, 2011	+	Dykstra et al., 2005
			n.s.	Aartsen & Jylhä, 2011
Mobility problems	n.s.	Dahlberg et al., 2015	n.s.	Dahlberg et al., 2015
20. Handgrip strength			n.s.	Taekema et al., 2010
21. Fatigue	+	Moreh et al., 2010	+	in people aged 85 at follow-up: Moreh et al., 2010
			n.s.	in people aged 78 at follow-up: Moreh et al., 2010; Taube et al., 2013
Fatigue change				
(ref. Not fatigued)				
Was fatigued			n.s.	Deckx et al., 2015
Became fatigued			n.s.	Deckx et al., 2015
Persistently fatigued			+	Deckx et al., 2015
Hearing status				
22. Self-reported			n.s.	Pronk et al., 2011
23. Speech reception			−	for emotional loneliness: Pronk et al., 2011
			n.s.	for social loneliness: Pronk et al., 2011
Hearing status change				
Self-reported			n.s.	Taube et al., 2013
Speech reception	n.s.	Pronk et al., 2014	n.s.	Pronk et al., 2014
Psychological factors ($n = 29$)				
1. Self-perceived mental health			−	Warner & Adams, 2016
2. Depression	+	Cacioppo et al., 2017; Cacioppo et al., 2010; Pikhartova et al., 2016	+	Brittain et al., 2017; Donovan et al., 2017
			n.s.	Cacioppo et al., 2017; Cacioppo et al., 2010
Depression change				
Remission			−	in people with depression: Houtjes et al., 2014

(*continued*)

Table 2. Continued.

Risk factor	Bivariate longitudinal association		Multivariable longitudinal association	
Fluctuating			n.s.	in people with depression: Houtjes et al., 2014
Chronic			+	in people with depression: Houtjes et al., 2014
3. Depressed mood	+	at T1-4, T6-7: Cacioppo et al., 2017; Dahlberg et al., 2015	+	Dahlberg et al., 2015
	n.s.	Aartsen & Jylhä, 2011; at T5: Cacioppo et al., 2017	n.s.	Cacioppo et al., 2017; Taube et al., 2013
Depressed mood change				
Increased depressed mood	+	Aartsen & Jylhä, 2011; Cacioppo et al., 2017; Dahlberg et al., 2015	+	Aartsen & Jylhä, 2011; Dahlberg et al., 2015
4. Anxiety			+	Wong & Waite, 2017
Affect				
5. Negative affect			+	Böger & Huxhold, 2018
6. Overall negative mood	n.s.	Cacioppo et al., 2017	n.s.	Cacioppo et al., 2017
7. Hopelessness	+	Gum et al., 2017	+	Gum et al., 2017
8. Feelings of uselessness	n.s.	Aartsen & Jylhä, 2011		
9. Nervousness	n.s.	Aartsen & Jylhä, 2011		
10. Irritability	n.s.	Aartsen & Jylhä, 2011		
Affect change				
Increased feelings of uselessness	+	Aartsen & Jylhä, 2011	+	Aartsen & Jylhä, 2011
Increased nervousness	+	Aartsen & Jylhä, 2011	+	Aartsen & Jylhä, 2011
Increased irritability	n.s.	Aartsen & Jylhä, 2011		
11. Perceived stress			n.s.	Cacioppo et al., 2010
12. Subjective age (older)	+	Pikhartova et al., 2016		
13. Life satisfaction			−	at T1: Taube et al., 2013
			n.s.	at T2: Taube et al., 2013
14. Self-esteem			n.s.	in widows/widowers: van Baarsen, 2002
Personality				
15. Openness			−	at T2: Taube et al., 2013
			n.s.	at T1: Taube et al., 2013
16. Extraversion			n.s.	in married people: Margelisch et al., 2017; Taube et al., 2013
17. Neuroticism			+	in married people, for emotional loneliness: Margelisch et al., 2017
			n.s.	Cacioppo et al., 2010; in married people, for social loneliness: Margelisch et al., 2017; Taube et al., 2013
18. Agreeableness			n.s.	Taube et al., 2013
19. Conscientiousness			n.s.	Taube et al., 2013
20. Self-centeredness	+	at T1-3, T6: Cacioppo et al., 2017	+	Cacioppo et al., 2017
	n.s.	at T4-5, T7: Cacioppo et al., 2017		
21. Resilience			n.s.	in married people: Margelisch et al., 2017
22. Mastery			−	Nicolaisen & Thorsen, 2012
23. Optimism	−	Rius-Ottenheim et al., 2012	−	Rius-Ottenheim et al., 2012
Causal beliefs for affiliation				
24. Effort	−	Newall et al., 2009	−	Newall et al., 2009
25. Context	n.s.	Newall et al., 2009	n.s.	Newall et al., 2009
26. Luck	+	Newall et al., 2009	+	Newall et al., 2009
Perceptions of loneliness				
27. Compared to ten years ago (ref. About the same)				
Less lonely			−	Brittain et al., 2017
More lonely			+	Brittain et al., 2017
28. Stereotypes	+	Pikhartova et al., 2016	+	Pikhartova et al., 2016
29. Expectations	+	Pikhartova et al., 2016	+	Pikhartova et al., 2016

Note: + significant positive association (high levels of the factor predict high levels of loneliness); − significant negative association (high levels of the factor predict low levels of loneliness); n.s. non-significant association; T0 baseline, T1 first follow-up, T2 second follow-up etc. regardless of time intervals between waves.

*A change variable is only counted as a unique risk factor where it is the only representation of that factor.

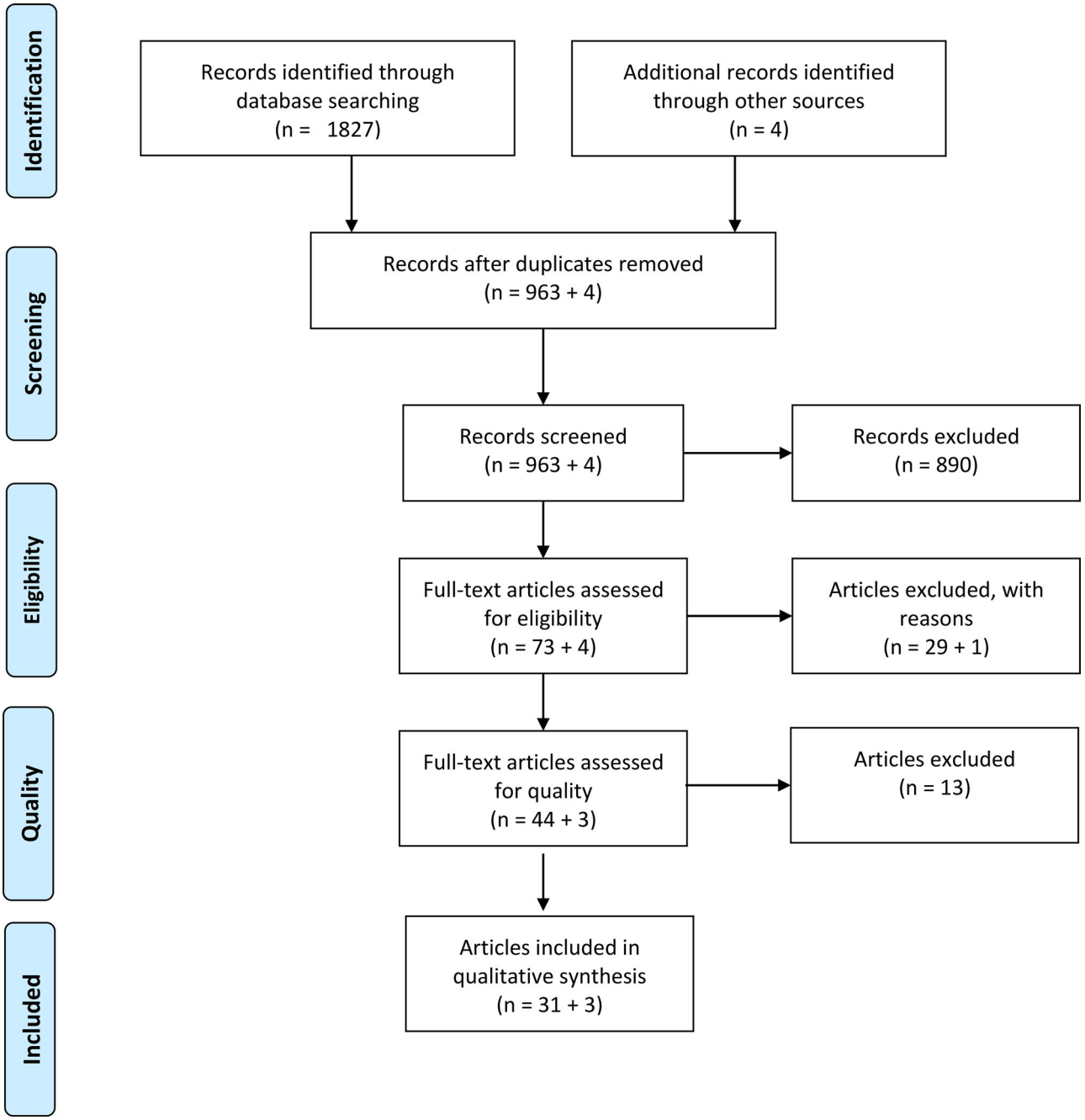

Figure 1. Flowchart of article selection.

original labels and operationalisations for all measures of risk factors in the articles are presented in Supplement D.

Results

Article selection

A flow chart of the selection process is presented in Figure 1. After screening of titles and abstracts of a total of 967 articles, 890 non-relevant articles were excluded and after assessment of the full text another 30 articles were removed (see Supplement B for reasons for exclusion).

Quality assessment was made of the 47 relevant articles (see Supplement C), with an overall grading of high quality, i.e. low risk of bias (2 articles), medium to high quality (3), medium quality (22), medium to low quality (7) and low quality (13). The 13 articles found to be of low quality were excluded from this review, thus $N = 34$ articles were included.

The characteristics of the included articles are presented in Table 1. The articles described studies from eleven countries, with the highest representation from the Netherlands (10 articles), the United States (9), the United Kingdom (4), and Sweden (3). One article was based on an international study that included Belgium and the Netherlands, and 17 articles were based on national studies, representing Germany, Israel, the Netherlands, Sweden, and the United States. While the earliest article was published in 1999, over half were published between 2015 and 2018.

Methods of included articles

Several major studies were the source of data for a considerable number of the articles included in this review: the Longitudinal Aging Study Amsterdam and/or the linked studies Living Arrangements and Social Networks of Older Adults and the Widowhood Adaptation Longitudinal Study

(5 articles); the English Longitudinal Study on Ageing (3); the National Social Life, Health, and Aging Project (3); the Chicago Health, Aging, and Social Relations Study (2); the Norwegian Study of the Life Course, Ageing and Generations (2); the Swedish Panel Study of Living Conditions of the Oldest Old (2); and the Zutphen Elderly Study (2).

A majority of the articles ($n = 20$) used several data collection methods. Among those based on a single data collection method, an interview-completion questionnaire was most common (8) followed by a self-completion questionnaire (3) or a combination of interview- and self-completion questionnaires (3). A response rate was reported in half of the articles ($n = 17$) and attrition reported in approximately a fifth (7). The response rate varied from 45% (Cacioppo, Chen, & Cacioppo, 2017; Cacioppo, Hawkley, & Thisted, 2010) to 87% (Dahlberg, Andersson, McKee, & Lennartsson, 2015; Taekema, Gussekloo, Maier, Westendorp, & de Craen, 2010), while attrition varied from 3% (Aartsen & Jylhä, 2011) to 48% (Pronk et al., 2014).

Fifteen of the articles included two waves of data collection in the analysis, eight articles included three waves and the remaining articles included more than three. Nearly half of the articles ($n = 16$) covered a period of up to five years from baseline data collection to final follow-up, with two articles including follow-ups of 20 years or more (Aartsen & Jylhä, 2011; Dahlberg, Andersson, & Lennartsson, 2018).

Participants

The analytic samples in the articles ranged in size from $N = 111$ (van Baarsen, 2002) to $N = 11{,}010$ (Böger & Huxhold, 2018). The majority of articles included a general population of older adults ($n = 24$), albeit often restricted to those living in the community ($n = 14$). However, some articles included a specific subgroup of the population, e.g. people with depression (Houtjes et al., 2014) or those who had recently lost their partner (van Baarsen, 2002). Some articles only included individuals that were not lonely at baseline (Aartsen & Jylhä, 2011; Moreh, Jacobs, & Stessman, 2010; Pikhartova, Bowling, & Victor, 2016).

The average age of the participants at baseline varied between 59 and 85 years, and approximately half of the articles had samples with an average age of 70 years or older (information not given in six articles). Women formed the majority of participants in 23 articles (information not given in six articles). Two articles were based on a study that only included men (Rius-Ottenheim et al., 2012; Tijhuis, de Jong Gierveld, Feskens, & Kromhout, 1999).

Measures of loneliness

There are two main approaches to measuring loneliness: via a single item or via multi-item scales. As shown in Table 1, over a third of the articles ($n = 13$) measured loneliness via the de Jong Gierveld Loneliness Scale, usually the 11-item version ($n = 11$); and nearly a third of the articles ($n = 11$) measured loneliness via the UCLA Loneliness Scale, usually the 3-item version ($n = 9$). In the remaining articles ($n = 10$) single items were used to measure loneliness. While the wording and response options of the single items varied across articles, all measured frequency of loneliness, usually with four response options.

Measures of risk factors for loneliness

Supplement D provides an overview of the risk factors for loneliness examined in each article and how these factors were described and measured. We grouped the risk factors into five main categories: demographic; socio-economic; social; health-related; and psychological. In 34 reviewed articles we found 120 unique risk factors. This figure includes two risk factors measured only as change variables (factors analysed as both standard predictor variables and as change variables are counted once).

Results of risk factors for loneliness

Table 2 presents the results of risk factors for loneliness. To simplify the presentation, the results of some unique risk factors that occupy a similar conceptual area are grouped together. For example, within the main category of socio-economic factors, the unique risk factors 1) not having enough money and 2) household assets/wealth are grouped together under the label *financial situation*.

Demographic factors

Measures of *age* and *gender* were included in most of the articles, although sometimes without presentation of their associations with loneliness. In bivariate analyses an increased risk of loneliness was found in people of greater age in four out of six articles (Dahlberg et al., 2015; Newall et al., 2009; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016). However, a positive association between age and loneliness was found in multivariable analyses in only 4 out of 16 articles (Donovan et al., 2017; Dykstra, van Tilburg, & de Jong Gierveld, 2005; Sutin, Stephan, Carretta, & Terracciano, 2015; Taube, Kristensson, Midlöv, Holst, & Jakobsson, 2013).

Similarly, whereas five out of six articles found an increased risk of loneliness for women in bivariate analyses (Aartsen & Jylhä, 2011; Cohen-Mansfield, Shmotkin, & Goldberg, 2009; Dahlberg et al., 2015; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016), only 2 out of 15 articles found a positive association in multivariable analyses (Cohen-Mansfield et al., 2009; Donovan et al., 2017) while 2 articles found a negative association (Dykstra et al., 2005; van Baarsen, 2002).

Ethnicity has only been examined as a longitudinal risk factor in five articles. One article (Warner & Adams, 2016) found that being of Hispanic ethnicity compared to White reduced the risk of being lonely, while another (Cacioppo et al., 2017) found this to be the case for Black ethnicity.

Socio-economic factors

Relatively few articles examined socio-economic risk factors. The financial factors examined were *household income*, *income-to-needs ratio* and *financial situation*. The only article to examine household income at the bivariate level found a negative association with loneliness (Pikhartova et al., 2016), while of the three articles examining this relationship at the

multivariable level only one found an association, where medium to high and low household income increased the risk of loneliness relative to high household income (Donovan et al., 2017). One article examined the income-to-needs-ratio and found no association with loneliness (Hawkley & Kocherginsky, 2018). Four articles examined the financial situation of older adults: out of two articles examining the relationship between not having enough money and loneliness, one article found a positive association (Cohen-Mansfield et al., 2009); while one out of two articles found that household assets or wealth decreased the risk of loneliness (Donovan et al., 2017).

Socio-economic position was examined via measures of *education*, *social status* and *employment status*. Higher levels of education were associated with a decrease in the risk of loneliness in two out of five articles in bivariate analyses (Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016) and in two out of ten articles in multivariable analyses (Donovan et al., 2017; Sutin et al., 2015). One article examined social status, finding a negative association with loneliness (Pikhartova et al., 2016). The same article found being employed to be negatively associated with loneliness in a bivariate analysis, whereas the only article to examine being employed at the multivariable level found no association (Hawkley & Kocherginsky, 2018).

Social factors

Many different social factors were examined. *Marital or partner status* was considered in fifteen articles. Three out of five articles found that being married/partnered reduced the risk of loneliness in bivariate analyses (Cohen-Mansfield et al., 2009; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016), while five out of 11 articles found the same association in multivariable analyses (Deckx et al., 2015; Dykstra et al., 2005; Nicolaisen & Thorsen, 2012; Pikhartova et al., 2016; Tijhuis et al., 1999; Yang, 2018). One article found an increased risk of loneliness for widowed persons in both bivariate and multivariable analyses (Dahlberg et al., 2015). However, Brittain et al. (2017) found that compared to not being widowed, being widowed in the last four years was not associated with loneliness, while being widowed for more than five years was associated with a decreased risk of loneliness.

With regard to *marital or partner status change*, five out of six articles that examined partner loss (i.e. becoming separated, divorced or widowed) found an increased risk of loneliness (Aartsen & Jylhä, 2011; Dahlberg et al., 2015; Dykstra et al., 2005; Nicolaisen & Thorsen, 2014; Tijhuis et al., 1999).

Living arrangement was analysed at bivariate level in two articles and at multivariable level in six articles. Three articles found that living alone increased the risk of loneliness (Brittain et al., 2017; Newall et al., 2009; Taube et al., 2013), while one article found that household size decreased the risk of loneliness (Pikhartova et al., 2016). Two out of three articles that examined the relationship between being in residential care and loneliness found a positive association (Brittain et al., 2017; Tijhuis et al., 1999).

Social contacts was examined in a variety of ways. One out of two articles found higher numbers of social contacts reduced the risk of loneliness in bivariate analyses (Dahlberg et al., 2015), although no association was found in multivariable analyses in two articles. In multivariable analyses, three out of five studies found that a larger social network was protective of loneliness (Böger & Huxhold, 2018; Donovan et al., 2017; Dykstra et al., 2005). Pikhartova et al. (2016) found that a greater number of close relationships reduced the risk of loneliness. Various aspects of *social contacts change* were also examined. One article found that the loss of close friends increased the risk of loneliness (Aartsen & Jylhä, 2011), although this association became non-significant at the multivariable level; and one article found that a reduction in one's social network increased the risk of loneliness (Dykstra et al., 2005). In five other analyses of aspects of social contact change across three articles, all associations with loneliness were non-significant.

Relationship quality and *relationship quality change* was almost exclusively examined in multivariable analyses. In the only article presenting bivariate analyses, Margelisch, Schneewind, Violette, and Perrig-Chiello, (2017) found high marital satisfaction to be negatively associated with social and emotional loneliness, although only the association with social loneliness remained significant in multivariable analyses. Warner and Adams (2016) found a negative association with loneliness when examining positive marital quality. Nine other aspects of relationship quality were examined across four articles, but an association with loneliness was found in only two analyses: higher friendship strain (Hawkley & Kocherginsky, 2018) and receiving verbal abuse by family (Wong & Waite, 2017) both increased the risk of loneliness. When considering relationship quality change, Yang (2018) found that a reduced closeness to one's partner was positively associated with loneliness, while Warner and Adams (2016) found increased positive marital quality reduced risk. Neither change in negative marital quality nor change in family and friendship strain were associated with loneliness (both Warner & Adams, 2016).

Social support was examined in seven articles. Cacioppo et al. (2010) found social support to reduce the risk of loneliness. Other aspects of social support were examined in 11 multivariable analyses across 5 articles, resulting in three associations with loneliness: marital support prior to widowhood (van Baarsen, 2002), family support (Hawkley & Kocherginsky, 2018; Wong & Waite, 2017), and emotional support (Dahlberg et al., 2018) all reduced the risk of loneliness. Emotional support also reduced the risk of loneliness at the bivariate level in one out of two articles (Dahlberg et al., 2018).

When examining *social activity* and/or *social activity change*, greater social activity was found to decrease the risk of loneliness at the bivariate level in one out of three articles (Newall et al., 2009) and in each of three articles at the multivariable level (Böger & Huxhold, 2018; Dahlberg et al., 2018; Newall et al., 2009). Specific social activities were investigated in five analyses across four articles, with four non-significant analyses and one in which being a member of organisations and active in the neighbourhood was negatively associated with loneliness (Pikhartova et al., 2016). One article examined social activity change and found that a reduction in social activity increased the risk of loneliness (Aartsen & Jylhä, 2011).

Life events was examined in three articles. No association with loneliness was found for either traumatic or significant live events, but positive associations were found for each of three childhood events (Nicolaisen & Thorsen, 2014). Sutin et al. (2015) found an increased risk of loneliness in individuals that had experienced *discrimination* based on: age; weight; physical disability; or physical appearance. Discrimination based on other factors was not associated with loneliness.

Health-related factors

Negative associations with loneliness were found in three out of four articles that examined *self-perceived health* in bivariate analyses (Cohen-Mansfield et al., 2009; Nicolaisen & Thorsen, 2014; Pikhartova et al., 2016) and in three out of six articles in multivariable analyses (Dykstra et al., 2005; Tijhuis et al., 1999; van Baarsen, 2002). Self-perceived health compared to people the same age was also found to be negatively associated with loneliness (Newall et al., 2009), but self-perceived physical health was not (Hawkley & Kocherginsky, 2018). *Self-perceived health change* was examined in five articles, and two articles found a reduction in self-perceived health to increase the risk of loneliness (Dykstra et al., 2005; Tijhuis et al., 1999).

A greater number of *health conditions* was found to increase the risk of loneliness at the bivariate level in one article (Newall et al., 2009), but no associaiton was found at the multivariable level in two articles (Böger & Huxhold, 2018; Donovan et al., 2017). Various health conditions and general measures of health were examined in five articles. Co-morbidity (Cohen-Mansfield et al., 2009) and leg pain (Taube et al., 2013) were found to increase loneliness, while health status was found to decrease loneliness (Newall et al., 2009).

While three articles examined *cognitive functioning* and found no association with loneliness, one article focusing on *cognitive functioning change* found that compared to not being impaired, both becoming or being persistently impaired increased risk (Deckx et al., 2015). Memory functioning was found to decrease the risk of loneliness in one article (Ayalon, Shiovitz-Ezra, & Roziner, 2016)

Functional limitations and *functional limitations change* were variously examined. Two articles that considered limitations in activities of daily living (ADLs) found positive associations with loneliness (Hawkley & Kocherginsky, 2018; Warner & Adams, 2016). Two articles examined limitations in instrumental activities of daily living (IADLs), one of which found a positive bivariate association with loneliness, but no multivariable association (Newall et al., 2009). Limitations in ADLs and IADLs combined ((I)ADLs) were examined in five articles, of which two found positive associations with loneliness (Brittain et al., 2017; Dykstra et al., 2005). An increase in limitations in (I)ADLs was found to increase the risk of loneliness in one out of two articles (Dykstra et al., 2005). In the only article to consider mobility problems, a positive association with loneliness was found at the bivariate, but not multivariable, level, while changes in mobility problems had no association (Dahlberg et al., 2015).

Fatigue was examined in two articles, with one article finding a positive association with loneliness in a bivariate analysis while the multivariable analysis found the same association in participants aged 85 at follow-up, but not in those aged 78 (Moreh et al., 2010). Examining *fatigue change*, Deckx et al. (2015) found that compared to non-fatigued participants, there was an increased risk of loneliness in the persistently fatigued, but not for participants who became fatigued or who were no longer fatigued.

Psychological factors

Many different psychological factors were considered, but most in only a single article. However, several articles examined *depression* or *depressed mood*. Depression was found to increase the risk of loneliness in three out of three articles in bivariate analyses (Cacioppo et al., 2010, 2017; Pikhartova et al., 2016) and in two out of four articles in multivariable analyses (Brittain et al., 2017; Donovan et al., 2017). One article examined *depression change* in people with depression, and found remission to decrease and chronic depression to increase the risk of loneliness (Houtjes et al., 2014). Depressed mood was found to increase the risk of loneliness in two out of three articles in bivariate analyses (Cacioppo et al., 2017; Dahlberg et al., 2015) and in one out of three articles in multivariable analyses (Dahlberg et al., 2015). *Depressed mood change* was also considered in three articles, and an increase in depressed mood was found to be consistently positively associated with loneliness (Aartsen & Jylhä, 2011; Cacioppo et al., 2017; Dahlberg et al., 2015).

An additional 27 psychological risk factors were examined across 15 articles. *Self-perceived mental health* was found to decrease loneliness (Warner & Adams, 2016), while *anxiety* was found to increase loneliness (Wong & Waite, 2017). Various aspects of a*ffect* have been considered, with negative affect (Böger & Huxhold, 2018), hopelessness (Gum, Shiovitz-Ezra, & Ayalon, 2017), increased nervousness (Aartsen & Jylhä, 2011), and increased feelings of uselessness (Aartsen & Jylhä, 2011) all found to be positively associated with loneliness. The five factor model of *personality* (Costa & McCrae, 1985) has been examined in three articles. Openness was found to decrease loneliness at T2, but not T1 (Taube et al., 2013). Two articles found no association between neuroticism and global loneliness (Cacioppo et al., 2010; Taube et al., 2013). However, one article found that neuroticism increased the risk of emotional, but not social, loneliness (Margelisch et al., 2017). In one article, having an older *subjective age* was positively associated with loneliness (Pikhartova et al., 2016). Other articles found that *self-centeredness* increased loneliness (Cacioppo et al., 2017) and that *mastery* (Nicolaisen & Thorsen, 2012) and *optimism* (Rius-Ottenheim et al., 2012) decreased loneliness. Finally, different *perceptions of loneliness* have been examined, with both self-comparison processes (Brittain et al., 2017) and stereotypes and expectations of old age being associated with loneliness (Pikhartova et al., 2016).

Discussion

Main findings on risk factors' associations with loneliness

Many different risk factors were examined in the 34 articles in this review. While significant associations with loneliness

were plentiful, relatively consistent associations with loneliness across several articles were found for only a few risk factors. The risk factors that stand out in this respect are: not being married/partnered and partner loss; a limited social network; a low level of social activity; poor self-perceived health; and depression/depressed mood and an increase in depression.

Approximately half of the articles that examined being married/partnered found this to be associated with a decreased risk of loneliness, while loss of a partner was found to increase risk in almost all analyses. A previous review similarly found strong support for an increased risk of loneliness among people without a partner such as widows and widowers (Cohen-Mansfield et al., 2016).

Despite social contacts being examined in a variety of ways across several articles, there was surprisingly little evidence of an important role in loneliness. Still, in more than half of the articles that examined one's social network, a more extensive network decreased the risk of loneliness. A reduction in one's social network was also found to increase risk. Similarly, if religious activity is excluded then higher levels of social activity were found to decrease the risk of loneliness in a majority of analyses. The evidence for an association between social support and loneliness was inconsistent, and less than half of the analyses of relationship quality found an association. This review therefore provides a different picture to that of a meta-analysis of cross-sectional research of correlates of loneliness, which found that measures of quality in social relations had stronger associations with loneliness than measures of quantity (Pinquart & Sörensen, 2003). Our findings are also not fully consistent with socio-emotional selectivity theory (Carstensen, Fung, & Charles, 2003), in which it is argued that the active maintainence of a small number of emotionally meaningful relationships provides a foundation for well-being in later life.

Previous reviews based only or primarily on cross-sectional research found evidence of associations between physical and mental health factors and loneliness (Cohen-Mansfield et al., 2016; Pinquart & Sörensen, 2003). Our review found self-perceived health to be one of the most investigated risk factors, with more than half of the analyses indicating that good self-perceived health decreases the risk of loneliness. The evidence for an association between functional limitations and an increased risk of loneliness was more mixed, being consistent for ADL limitations in two articles but less consistent for IADL and (I)ADL limitations. The majority of analyses of depression found it increases the risk of loneliness, while an increase in depressed mood was found to increase risk in all analyses. A previous review has shown that depression and loneliness often co-occur and that there are reciprocal influences over time between loneliness and depressive symptomatology (O'Luanaigh & Lawlor, 2008).

Some findings relating to other risk factors are worth highlighting. Previous reviews based primarily on cross-sectional studies found evidence that loneliness is associated with female gender and greater age (Cohen-Mansfield et al., 2016; Pinquart & Sörensen, 2003). These findings are echoed in our review when considering analyses at the bivariate level, but not those at the multivariable level. This failure to replicate bivariate associations at the multivariable level suggests that these associations are at least partly due to factors that co-occur with female gender and greater age, such as reduced health and functioning and widowhood. There were also indications in our review that low income and poor financial conditions increase the risk of loneliness, but most articles examining education did not find an association. These findings resonate with a resource perspective on loneliness (see Tesch-Römer & Huxhold, 2019) and can also be compared with those of a meta-analysis in which both income and education were associated with loneliness, with the greatest effect for income (Pinquart & Sörensen, 2003). Finally, while only two articles considered perceptions of loneliness via self-comparison processes and stereotypes of ageing, all analyses found significant associations with loneliness (Brittain et al., 2017; Pikhartova et al., 2016). Taken together with the finding that an older subjective age was associated with an increase in loneliness (Pikhartova et al., 2016), these results are consistent with a cognitive perspective on loneliness (see Tesch-Römer & Huxhold, 2019) and suggest that older adults' subjective perceptions of loneliness and old age merit further investigation.

Research focus and gaps

The amount of longitudinal research on risk factors for loneliness has more than doubled in the last few years, and the range of risk factors that have been investigated is considerable. However, many of these risk factors have been considered in, at best, a few articles, and some in only one. Thus, there were several articles focusing on social contacts as a risk factor, yet social contacts was operationalised variously across articles such that, e.g. the number of close relationships or having close friends were each analysed as risk factors only once. Health-related factors have mostly been examined via self-perceived health and (I)ADL limitations. Perhaps surprisingly only a few articles examined cognitive impairment as a risk factor for loneliness, while the only form of sensory impairment considered was hearing impairment. Similarly, research on psychological factors was dominated by a focus on depression and depressed mood, with most other psychological factors each investigated in only one article. Taken collectively, the current evidence-base for longitudinal risk factors for loneliness can be described as broad but shallow.

Even given the breadth of risk factors examined there were some notable absences. For example, no articles examined mental health issues such as personality disorders or psychosis nor existential factors that may contribute to loneliness. Social contact with children also received little attention. None of the reviewed articles examined the separate effects of having daughters or sons, or the effect of contact with grandchildren. These seem strange omissions given the important role of adult children in the informal care of older adults and the significant role of older adults in childcare and in the care of other older adults (Evandrou, Falkingham, Gomez-Leon, & Vlachantoni, 2018; Verbakel, Tamlagsrønning, Winstone, Fjaer, & Eikemo, 2017). Cross-sectional research has found that receiving informal care is associated with lower levels of emotional loneliness in older adults (Dahlberg & McKee, 2014) and that older adults with a perceived need of informal care

but receiving none have higher levels of social loneliness (Dahlberg & McKee, 2016). A recent cross-sectional study found that higher levels of stress in informal carers of people with dementia are associated with higher levels of loneliness (Victor et al., in press). However, a longitudinal study published after the inclusion period of this review found no association between being an informal carer and loneliness (Hajek & Konig, 2019).

Similarly, while three articles in our review analysed living in, or entry to, residential care, no articles considered social care more broadly, such as the receipt of home help, day care, respite care etc. Cross-sectional research has found that older adults in receipt of social care have higher levels of social loneliness (Dahlberg & McKee, 2014), while cross-country comparisons suggest that welfare states can enable social participation and reduce loneliness (Nyqvist, Nygard, & Scharf, 2019) and that differences regarding, e.g. material deprivation and lack of access to health care are associated with differences in loneliness (Morgan et al., 2021). The assessment of how such macro-level factors might influence loneliness is limited by the lack of international comparative longitudinal studies. In our review, only one article analysed data from more than one country, and that article did not present cross-country comparisons (Deckx et al., 2015). There is also a lack of research on the relationship between meso-level factors and loneliness, for example community-level factors or urban vs. rural residence, while factors on the border of meso- and micro-levels are also largely absent, e.g. neighbourhood integration (cf. Gibney, Zhang, & Brennan, 2020; Gyasi & Adam, 2020; Tesch-Römer & Huxhold, 2019).

Few risk factors were examined that could be said to relate to a life course perspective. Such a perspective when studying older adults can only truly be achieved through analysing data over a significant part of the lifespan. However, only two articles included follow-ups of over 20 years (Aartsen & Jylhä, 2011; Dahlberg et al., 2018).

Although 13 articles in this review used the bidimensional de Jong Gierveld Loneliness Scale, only 6 of them analysed emotional and social loneliness separately. A similar research limitation has been observed in longitudinal research on interventions to reduce loneliness (Masi, Chen, Hawkley, & Cacioppo, 2011). Although emotional and social loneliness are correlated, articles identified risk factors unique to each dimension (Deckx et al., 2015; Margelisch et al., 2017; Pronk et al., 2011; van Baarsen, 2002). There is thus a need for more longitudinal research into risk factors for loneliness that distinguishes between emotional and social loneliness.

Quality of included articles

The reviewed articles often lacked information on sampling frame and methodology, while response and attrition rates were often not reported and/or not analysed. Such problems were particularly common in articles based on the major longitudinal studies. Readers should not be required to seek out figures from secondary sources to reach an informed assessment of an article's quality. Data analysis was another area where a thorough quality assessment was often compromised. The analysis of longitudinal data can involve complex statistical modelling that cannot be satisfactorily described in a couple of sentences. Many clinical and medical journals have restrictive word counts for articles, which can limit the description of modelling to the point that an informed assessment of its adequacy is not possible.

The comparison of findings for risk factors across articles was made difficult by the variation in operationalisation and measurement of similar constructs, including loneliness. As noted elsewhere (Victor et al., 2018), it is difficult to judge the extent to which various single-items, scales and versions of scales measuring loneliness correspond to each other. Approximately a third of the articles in this review measured loneliness via a single item. While single-item measures can possess face validity, they may have limited sensitivity, particularly if the item has a small number of response options. This problem of limited sensitivity is exacerbated by two related issues: a) the frequently-reported finding that responses to loneliness items and scales are heavily skewed, and b) the common practice of dichotomising the loneliness measure, thus reducing its sensitivity even further. A further limitation of single-item measures is that they cannot discriminate between different dimensions of loneliness.

Strengths and limitations

This is the first systematic review of longitudinal risk factors of loneliness in older adults. One of the strengths of the review is its scope, that is, the inclusion of all variables examined for their predictive associations with loneliness. However, this scope means that it was not practical to provide a more nuanced assessment of each individual risk factor. The variability in the measurement of risk factors and of loneliness also militated against presenting the associations between risk factors and loneliness with more precision. The assemblage of individual risk factors into categories and the combination of results for similar constructs measured in different ways across articles, should be considered critically. For transparency and to facilitate analysis, descriptions of how each risk factor was operationalised in the articles are presented in this review.

As was true of most articles, we adopted $p<.05$ as the criteria of significance for the association between a risk factor and loneliness. However, few studies applied corrections for multiple testing or otherwise addressed the family-wise error rate. Over half the articles reviewed analysed data from only seven studies, so the problem of alpha inflation in these articles is particularly acute. This issue should also be considered in the context of the well-known bias in scientific publishing in which non-significant findings are less likely to be submitted for publication.

The review was limited to articles published in English describing research carried out in high income countries, although no article was excluded from the review on the latter criterion. As with all systematic reviews, there is a risk that we have failed to identify all relevant articles, for example, as a consequence of the search strategy and choice of databases. To minimise this risk, we applied a rigorous search strategy whereby we conducted searches in several databases and combined this with searches via other routes. The risk of rejecting relevant articles was reduced by using two independent researchers.

Conclusions: Further research and recommendations for practice

In 34 reviewed articles we found 120 unique risk factors. Many of these risk factors were significantly associated with loneliness. However, relatively few risk factors could be said to have compellingly consistent associations with loneliness across a considerable number of articles and at both bivariate and multivariable levels. With a handful of exceptions, we regard the evidence-base for longitudinal risk factors for loneliness to be broad but shallow. Additionally, there are several variables that demonstrate promise as potential longitudinal risk factors for loneliness where further research is justified and required; and, despite the range and quantity of risk factors examined there remain surprising omissions where theory or cross-sectional evidence would suggest investigation is warranted. Further longitudinal research that considers emotional and social dimensions of loneliness is also recommended; the failure to analyse these two dimensions separately has implications for the development of effective loneliness interventions.

An overview of reviews concluded that interventions to reduce loneliness designed for specific needs of targeted populations have a greater potential to be beneficial (Victor et al., 2018). Our review provides relatively strong evidence that certain sub-groups of the older adult population are at a higher risk of loneliness. These include: older adults that are not married/partnered, particularly those who have recently lost their partner; individuals with a limited social network and/or low levels of social activity; older adults with poor self-perceived health; and those with depression/depressed mood. If we are to reduce the levels of loneliness in the general adult population, this might best be achieved by using the resources available to develop interventions targeting older adults with the characteristics listed above. When developing interventions, thought should also be given to which risk factors are most easy to assess and change in older adults. Different intervention strategies will be required for risk factors that can be thought of as triggers for loneliness, such as the loss of a partner, those linked to an older adult's social context such as their social network and social activities, and those of a more dispositional nature, such as depression (cf. Pinquart & Sörensen, 2001).

Author contributions

Protocol development; relevance and quality assessments; review and final approval of manuscript: all authors. Data searches: A.F. and M.N. Data analyses; original draft of manuscript; funding acquisition: L.D. and K.J.M. Project management: L.D.

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Declaration of interest

Two of the authors have been involved in two of the articles included in this review.

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