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Review

A systematic review of the impacts of intergenerational engagement on older adults' cognitive, social, and health outcomes

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ABSTRACT

Background: Intergenerational engagement could benefit health and wellbeing within an ageing population. This systematic review evaluated the impacts of intergenerational engagement on cognitive, social, and health outcomes in healthy older adults and older adults with mild cognitive impairment.
Research design and methods: Comprehensive literature searches were undertaken, with records filtered according to pre-registered criteria. Study quality was formally assessed, and a narrative synthesis of the findings produced.
Results: Forty-four studies were reviewed. Regarding quantitative evidence, 4 out of 8 studies found significant intergenerational engagement effects on cognitive outcomes, 15 of 24 on social outcomes, and 21 of 31 on health-related outcomes. Qualitative evidence was also important for understanding perceived impacts and experiences of intergenerational programmes. Only 11 studies fully met criteria for high quality research, of which the majority focused on social outcomes.
Discussion and implications: There are a range of potential benefits of intergenerational engagement, most notably regarding anxiety, generativity, cross-age attitudes, and physical activity. However, heterogeneity in programme context, sample design, dosage, and duration indicate that more research is required to enable wider implementation and generalisability. Scientific rigour in both quantitative and qualitative research should also be employed as far as possible, to provide the highest quality evidence.

1. Introduction

To help maintain or promote health and wellbeing in ageing populations, more opportunities must be created for older people to participate in, and contribute to, their communities (World Health Organization, 2015). Community engagement can potentially encourage older adults to be more cognitively and physically active, and socially connected, while facilitating their health and independence. Enabling people to do meaningful work more flexibly in later life may also reduce demand on health and care services (Government Office for Science, 2016).

Adult ageing is typically associated with a variety of positive changes such as increased wisdom (Ardelt, 2010), enhancements in aspects of work performance (Ng and Feldman, 2008), and alterations in emotion regulation that can increase happiness (Charles, 2010). However, ageing is also associated with increased risk of developing diseases, and with declines in cognitive functioning, especially 'fluid' (speeded/processing intensive) functioning (Reuter-Lorenz and Lustig, 2016). Brain markers of cognitive ageing may include reduced grey matter volume and thickness, and white matter integrity (Hedden et al., 2016; Raz et al., 2005). Older adults may also be affected by neurological and mental disorders, of which the most common are dementia, depression and anxiety (World Health Organization, 2017). The main stressors experienced in older age are a progressive decline in functional ability, decreases in general health, and a loss of close relationships through bereavement that can result in loneliness or isolation (Bodner and Bergman, 2016; Colón-Emeric et al., 2013; Finlay and Kobayashi, 2018). In addition, older adults may experience ageist attitudes from others, or hold negative attitudes about ageing themselves, that can negatively affect their physical and mental health (Bryant et al., 2012; Levy, 2009).

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According to the engagement hypothesis, older adults may benefit from increased social and intellectual activity (Stine-Morrow et al., 2007). The engagement model originated from epidemiological studies demonstrating that complex work, social networks, and general busyness benefit cognition and health (Bennett et al., 2006; Jopp and Hertzog, 2007; Lövdén et al., 2005). Regarding cognition specifically, the scaffolding theory of aging and cognition (STAC; Reuter-Lorenz and Park, 2014) also states that cognitive stimulation, social and intellectual engagement, and physical activity can all benefit brain structure and functioning (see also Hertzog et al., 2008). Furthermore, through a life course developmental lens, Erik Erikson proposed that successful aging is accompanied by the desire to be needed by 'giving back' to younger generations (Erikson et al., 1986).

Intergenerational engagement (IE) programmes are a specific form of community participation developed to provide resources and infrastructures that engage older adults and younger generations in scalable ways. IE programmes typically involve scheduling activities that are designed to bring members of different age groups together for the benefit of all participants (Henkin and Newman, 1985). For older adults, IE provides opportunities to contribute their skills and knowledge as volunteers in schools and the community at large (Fried et al., 2004; Wilson et al., 2013). Their experience-based competencies help establish their position as mentors, tutors, and role models to younger generations, and in turn, lead to mutual understanding and better-connected communities (Hilson and Ennals, 2007). Thus, older adults may use their accumulated experience and wisdom to 'give back' to society and younger generations. By engaging in meaningful, nurturing, and productive activities, they can help alleviate specific challenges that may exist within communities, such as limited resources within schools (Rebok et al., 2004). Although efficacy of IE programmes has been demonstrated and promoted in a number of countries (Carlson et al., 2008; Fujiwara et al., 2009), both qualitative and quantitative evidence of the impact of IE on older adults has still not been sufficiently evaluated. Existing systematic reviews are focused on specific outcomes, on only on large-scale interventions, or are not sufficiently comprehensive relative to the available evidence.

In a previous review, Canedo-García et al. (2017) investigated the impacts of IE in the context of large, randomised, controlled trials (RCTs). They examined the effectiveness of evidence-based interventions, contrasting face-to-face, virtual, and combined (i.e. both face-to-face and virtual) programme modalities. Their review focussed on three grouping variables including the general focus or quality-of-life dimension addressed by the study (e.g., emotional wellbeing, interpersonal relations), the characteristics of the reviewed study (e.g., intervention modality, duration), and empirically-based-interventions (EBI) indicators or controls (e.g., recording of sessions, follow-ups). No significant differences were found based on the intervention mode employed, but effectiveness was influenced by variables such as the participants' disabilities or literacy level. Ronzi et al. (2018), on the other hand, examined all empirical studies available, but their systematic review was limited to physical and mental health outcomes and focussed solely on interventions designed to foster respect and social inclusion. They found that IE programmes were associated with an overall positive impact on health outcomes, such as depression, quality of life, and mental and physical health. Likewise, Peters et al. (2021) provided an overview of IE programmes that examined social, cognitive, and health-related outcomes. They highlighted that all included studies showed positive effects in general, and also that study quality was usually limited. However, their review was not intended to comprise a comprehensive evaluation of the effectiveness of IE in terms of specific outcomes, and did not capture all of the available evidence on the topic.

The current objective was to review the impacts of IE on measures of cognition, health and wellbeing, and social function. Uniquely, we considered all available modalities of IE (e.g., older adults working with children or young adults, and in a school or wider community context), and synthesised all available evidence on their impacts. The present systematic review is therefore more comprehensive than previous reviews and is the first to include both qualitative and quantitative research focused on specific cognitive, social, and health outcomes of IE together, along with a detailed narrative review. We therefore aimed to identify a wider range of potential benefits of this form of holistic engagement for older people, while also carefully considering study quality and the extent of evidence available on each outcome.

2. Methods

This review followed the Centre for Reviews and Dissemination's guidelines for undertaking reviews in health care (Centre for Reviews and Dissemination, 2009). The protocol was pre-registered with PROSPERO (Central Registration Depository: 42017082732) and is available at: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42017082732.

2.1. Search strategy

A systematic literature search was initially conducted on 01/12/2017, with searches repeated on 01/03/2019 and 01/07/2020 to check for any new publications. Four electronic databases were used: PubMed, Web of Science, PsycInfo, and the Cochrane Library. Searches were restricted to the English language, but not by date of publication. The specific search strategy included the intersection of the following terms: [(intergeneration* OR cross-generation* OR civic engagement) AND (school OR community OR child* OR teaching OR learning OR teen* OR youth OR adolescen* OR college OR university) AND (older adult OR elder* OR senior OR aged OR ag?ing OR MCI OR mild cognitive impairment) AND (cognit* OR executive OR speed OR attention* OR memory OR brain OR neuro* OR social OR network OR interaction OR support OR physical OR attitude* OR stereotyp* OR mental health OR depressi* OR anxi* OR stress OR loneliness OR isolation OR health OR physical OR wellbeing OR fit* OR activ* OR exercis*)]. The search was supplemented by hand searches of references of prior reviews and eligible studies, and expert recommendations, to ensure as far as possible that all relevant papers were included.

2.2. Inclusion and exclusion criteria

Studies were included if they: (1) involved participants aged 60 and older (individual studies with participants younger than 60 years were considered if the mean age was 60 or higher); (2) involved older adults with either healthy cognition or mild cognitive impairment (MCI); (3) described engagement between older adults and children (under 16 years) or younger adults up to approximately 25 years (e.g., college/university context); (4) included data regarding potential change in older adults from baseline to a later timepoint on at least one outcome within the cognitive, social, and health categories. All empirical study designs were considered eligible for the review including RCTs, observational studies, quasi-experimental studies, and qualitative studies (i.e., focus groups, interviews, field notes, survey).

2.3. Data screening and selection

Search results were uploaded into EndNote software and screened for duplicates. The first reviewer (AK) read and screened titles and abstracts of all the records against the predetermined inclusion criteria. Following the Centre for Reviews and Dissemination (2009) guidelines, the general steps for avoiding bias in selecting studies for inclusion and minimising the risk of missing any eligible records were applied. As such, records that were clearly not relevant or addressed the topic but failed on one or more criteria (e.g., population) were excluded. Further, if the records appeared to meet the inclusion criteria, but the decision could not definitely be made at that stage of selection, the reviewer opted for over-inclusion. A second reviewer (DS) independently conducted the title and abstract screening on a

randomly selected 25 % of the records, following the same steps of the decision-making process. Whenever there were disagreements, the two main reviewers discussed the discrepancies and decided which records were to be included. A third reviewer (LN) was available to help resolve any discrepancies if required. After screening the 25 % sample, the reviewers obtained a Cohen's kappa (κ) of 0.64. To increase the reliability of the decision process and minimise risk of error, following the Centre for Reviews and Dissemination (2009) guidelines, the full text of all remaining records was then screened by two reviewers independently, who achieved κ = .69, indicating substantial agreement.

2.4. Data extraction

Two reviewers (AK & DS) conducted data extraction for all included records, using separate standardised extraction forms for qualitative and quantitative data, to reduce bias and improve inter-rater reliability. Both forms were completed if studies used mixed methods. The form for extracting quantitative data contained tables tailored to the review question and based on protocols from the Cochrane Collaboration [Effective Practice and Organisation of Care (EPOC), 2017]. Qualitative studies and qualitative elements of mixed-methods studies were extracted based on the criteria derived from the NICE data extraction

Table 1
Assessment of research quality using the Mixed Method Appraisal Tool (MMAT; Hong et al., 2018a).

		1. QUALITATIVE STUDIES					2. QUANTITATIVE, RANDOMIZED CONTROLLED TRIALS					3. QUANTITATIVE, NON-RANDOMIZED STUDIES					5. MIXED METHODS STUDIES				
First author	Year	1.1. Is the qualitative approach appropriate to answer the research question?	1.2. Are the qualitative data collection methods adequate to address the research question?	1.3. Are the findings adequately derived from the data?	1.4. Is the interpretation of results sufficiently substantiated by data?	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?	2.1. Is randomization appropriately performed?	2.2. Are the groups comparable at baseline?	2.3. Are there complete outcome data?	2.4. Are outcome assessors blinded to the intervention provided?	2.5. Did the participants adhere to the assigned intervention?	3.1. Are the participants representative of the target population?	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	3.3. Are there complete outcome data?	3.4. Are the confounders accounted for in the design and analysis?	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?	5.2. Are the different components of the study effectively integrated to answer the research question?	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?
Adam, J.E.	1992											Yes	Yes	Yes	No	Yes					
Alcock, C.L.*	2011	Yes	Yes	Yes	Yes	Yes															
Barbosa, M.R.	2020	Yes	Yes	No	No	No						Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No
Barnard, D.	2014	Yes	Yes	No	No	No															
Belgrave, M. J.	2018	Yes	Yes	Yes	No	No						No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No
Carlson, M.C.* Fried, L.P. Tan, E.J.	2008 2004 2006						Yes[a]	Yes	Yes	Yes[b]	Yes										
Carlson, M.C.*	2009						Yes[a]	Yes	Yes	Yes[b]	Yes										
Carstensen, C.	1982											Yes	Yes	Yes	No	Yes					
Chapman, N.J.*	1990	Yes	Yes	Yes	Yes	Yes						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chippendale, T.	2015	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No[b]	Yes						Yes	Yes	Yes	Yes	No
Chung, S.	2020											No	No	Yes	No	Yes					
de Souza, E.M.	2007						Yes	Yes	Yes	No[b]	No										
DeMichelis, C.	2015	Yes	Yes	Yes	Yes	Yes						No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Ehlman, K.*	2014											Yes	Yes	Yes	Yes	Yes					
Fujiwara, Y.	2013											Yes	Yes	No	Yes	Yes					
Gaggioli, A.	2004											No	Yes	Yes	No	Yes					
Gamliel, T.*	2014	Yes	Yes	Yes	Yes	Yes						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gruenewald, T.* Parisi, J.M.	2016 2014						Yes[a]	Yes	Yes	Yes[b]	Yes										
Halpin, S.N.	2017	Yes	Yes	Yes	Yes	No						No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hernandez, C.R.	2008											Yes	Yes	Yes	No	Yes					
Hsu, S.*	2014											Yes	Yes	Yes	Yes	Yes					
Johnson, W.	2014	Yes	Yes	Yes	Yes	Yes						Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
June, A.	2020											No	Yes	Yes	No	Yes					
Kamei, T.	2011	Yes	Yes	Yes	No	No						No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Lee, O. E.-K.	2019	Yes	Yes	Yes	Yes	Yes						No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No
Lin, Y.-C.	2017	Yes	Yes	No	No	No						No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Mahoney, N.	2019	Yes	Yes	Yes	Yes	Yes						Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Meshel, D.S.	2004											Yes	Yes	Yes	No	Yes					
Murayama, Y.	2015											Yes	Yes	No	Yes	Yes					
Newman, S.	1995											No	Yes	Yes	Yes	Yes					
Perry, C.K.	2011	Yes	Yes	Yes	No	No						No	Yes	No	No	Yes	Yes	Yes	Yes	No	No
Pinquart, R.	2000											No	Yes	Yes	No	Yes					
Posada, M.M.	2006											No	Yes	Yes	Yes	Yes					
Sakurai, R.	2016											Yes	Yes	No	Yes	Yes					
Sakurai, R.	2018											Yes	Yes	No	No	Yes					
Sanders, M.J.	2013											Yes	Yes	No	No	Yes					
Santini, S.	2018	Yes	Yes	Yes	Yes	No															
Sng, J. R. H.	2020											No	Yes	Yes	No	Yes					
Strand, K.A.	2014	No	Yes	No	Yes	Yes						Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Sun, Q.*	2019											Yes	Yes	Yes	Yes	Yes					
Tan, E.J.*	2009											Yes	Yes	Yes	Yes	Yes					
Wilson, N.J.*	2013	Yes	Yes	Yes	Yes	Yes															
Xu, X.	2016											Yes	Yes	No	Yes	Yes					
Young, T.L.	2013											No	Yes	No	Yes	Yes					

NB: Criteria set 4 ('Quantitative Descriptive') was not presently relevant for any included studies and so was removed; *studies that met all the criteria.
[a]Randomisation protocol described by Fried et al. (2013).
[b]Further details received by authors.

form [National Collaborating Centre for Mental Health (UK), 2007] and the Cochrane Collaboration (Noyes and Lewin, 2011). The third reviewer (LN) validated the extracted findings against records and discussed any disagreements with the first reviewer. Where there were any uncertainties, authors of the included studies were contacted to request clarification.

2.5. Quality appraisal

Each record was assigned a quality evaluation for each methodological component using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018a, 2018b). This provided appropriate criteria for each of the research designs involved. Qualitative, RCTs, and non-randomised controlled studies were each assessed on five criteria. Mixed-methods studies were evaluated on 15 criteria, including an evaluation of the qualitative component, the quantitative component, and the integration of both sources of findings. Each criterion was rated as being sufficiently met or not, leading to scores out of 5 for qualitative and quantitative studies, and out of 15 for mixed-methods studies. Two reviewers (AK & DS) independently conducted the appraisal and established final ratings through discussion and in consultation with the third reviewer (LN). No overall score from the ratings of the included studies was calculated, as advised by Hong et al. (2018a, 2018b; see also Glenny, 2005), as an overall score does not provide enough information regarding which aspects of the studies were inadequately addressed or performed (Hong et al., 2019; Viswanathan et al., 2012). Therefore, we used the MMAT to detail the ratings of each criterion to better inform readers about the perceived quality of the included studies (see Table 1 for MMAT evaluations & Supplementary Table 1 for evaluation notes).

2.6. Data synthesis

Results were grouped according to measured outcomes and were compiled for a narrative synthesis. The three main outcomes were cognition, health and wellbeing, and social functioning. The findings were organised and grouped according to similarity of outcomes and were also presented in tabular form (Popay et al., 2006).

3. Results

3.1. Studies included

Initially, 13,313 records were obtained from the searches. After removing duplicates, the titles and abstracts of 8956 records were screened for eligibility. Then, 248 records were filtered based on the full text, determining their relevance. Reasons for exclusion included insufficient research data (e.g., no outcome measures, results only for young participants) or incomplete methods description. Following the guidance of good practice provided by the Centre for Reviews and Dissemination (2009), multiple reports from the same study were treated as a single study, while still referring to all the records [e.g., Carlson et al. (2008); Fried et al. (2004), and Tan et al. (2006) were classed as one study as they drew upon the same data]. A total of 44 articles and 3 theses (based on 44 studies: 26 quantitative, 4 qualitative, 14 mixed-methods), met all inclusion criteria and were selected for further analysis [see Preferred Reporting Items for Systematic Reviews

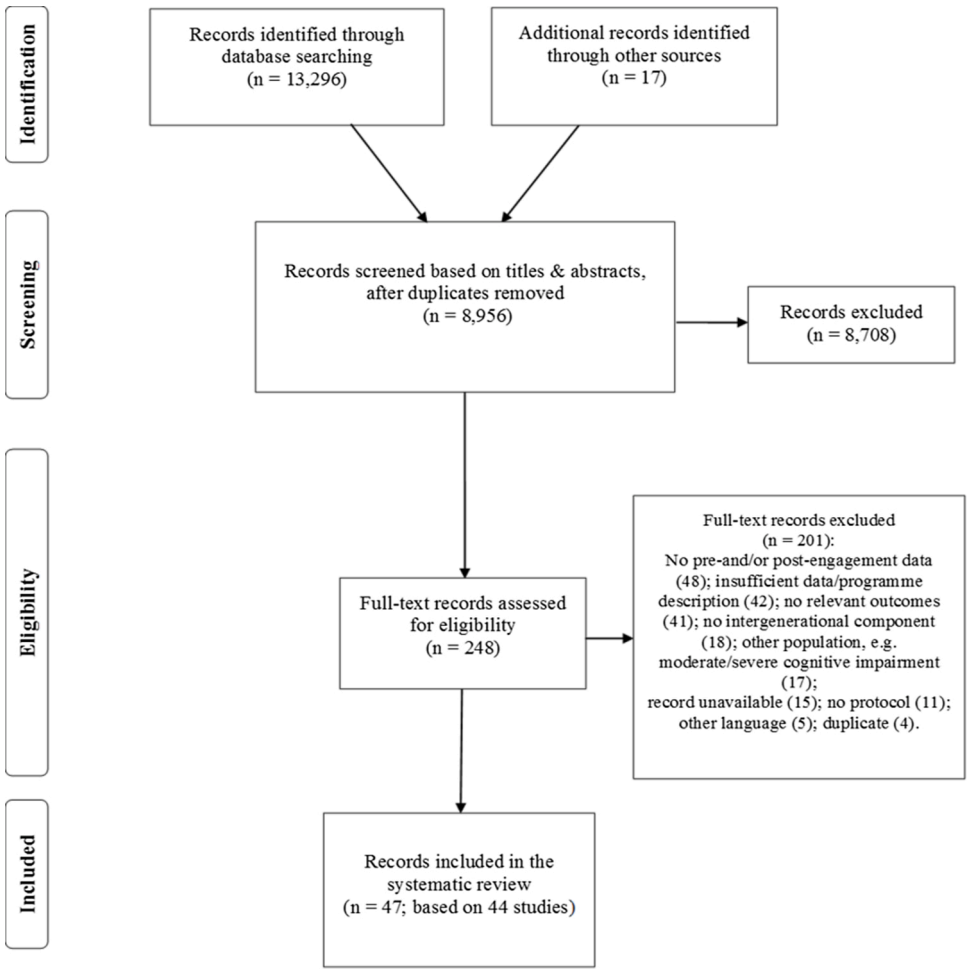

Fig. 1. PRISMA (Moher et al., 2009) flowchart of record selection process.

and Meta-Analyses (PRISMA) flow diagram, Fig. 1; Moher et al., 2009]. Eligible studies were published between 1982 and 2020.

3.2. Study designs

Of 40 studies providing quantitative data, 5 used RCTs and 35 applied experimental/quasi-experimental designs [i.e., 14 non-randomised controlled trials in which people were allocated to different intervention groups using methods that are not random, including allowing participants to self-select their condition (Sakurai et al., 2016), and 21 pre- and post-intervention studies with no control group; see Table 2]. Controlled trials included a range of control groups: 1) wait-list; 2) other activities; 3) older adults involved in the same activities, but no intergenerational contact allowed; 4) older adults receiving in-home service from youths; and 5) passive (no new activity) controls. One study used two comparison groups – a non-intervention control group and an intervention involving professionals.

The 18 studies that reported qualitative findings (i.e. qualitative studies, and quantitative studies with a qualitative component) used the following methods to collect data: focus groups; interviews; field notes; qualitative pre- and post-intervention survey; reflective journal; post-intervention survey (open-ended questions); post-intervention written description of the programme; and written reflective assignments.

3.3. Study participants

The sample size of the selected studies ranged from 6 to 702 participants. The majority of participants were female in most studies, with four studies including females only and two involving males only. Study participants were recruited from either the areas around the chosen intervention setting or from the programme location itself (e.g., nursing homes, community centres).

Participants ranged from 50 to 100 years of age. Generally, the samples comprised healthy older adults, but two also included older adults with MCI (Carlson et al., 2008; Posada, 2006). Of the 44 considered studies, 17 clearly specified the health status of their participants. In the remaining 27 the health status could be assumed as relatively good considering: participants' eligibility for the roles assigned in the programmes; that medical approval was provided when the programme involved physical activity; and participants' ability to function independently. Seven studies screened participants using the Mini-Mental State Examination (MMSE; Folstein et al., 1975); eleven collected self-assessments of health status; one used the Mini-Cog (Borson et al., 2000); one applied the Short Portable Mental Status Questionnaire (Pfeiffer, 1975); and two applied the Short-Form Health Survey (Fukuhara and Suzukamo, 2004; Ware et al., 1996). Twenty-seven studies did not screen their participants' health status.

3.4. Intervention formats and settings

All programmes were community-based, and the majority were conducted in one local setting. Interventions were implemented in: kindergarten/elementary schools (helping children with their academic activities); senior centres (exergaming, computer training, reminiscence groups, knowledge exchange with students, writing stories, making puppets); nursing homes (playing games, sharing stories, musical activities); community centres (computer training, talks, excursions); Men's Sheds (craftwork and social interaction); a high school (discussion groups); a college (games and handicrafts); a university (interviews); a youth centre (photography); a community gym (tai-chi classes); and a health centre (health promotion sessions). Some of the studies involved activities organised in a range of different locations, including churches, museums, or private houses (mentoring, 'exergaming', discussion groups, tutoring).

3.5. Intervention duration and dosage

The programme durations ranged from one week to seven years (Table 2). Duration of a single session ranged from 15 min to 7.5 h. The majority of studies involved only one session per week that lasted between 30 min and 3.5 h. The most intensive studies reported four weekly sessions, each lasting for 15 min to almost 4 h. The least frequent interventions involved only one intergenerational session per month. For nine studies, the dose (i.e. hours of exposure) of weekly engagement was not specified.

3.6. Study quality evaluations

Eleven of the included studies met all MMAT assessment criteria (Hong et al., 2018a, 2018b; Table 1), indicating highest quality methods and scientific rigour. The main weaknesses of the quantitative studies included: small sample size; lack of control group in 21 of the evaluated studies; and high drop-out/data exclusion rates of up to 49 % (6-year study; Sakurai et al., 2018) or approximately 56 % (7-year study; Sakurai et al., 2016; see also Supplementary Table 1). A relatively high drop-out was even observed in a one-week intervention (27 %; Xu et al., 2016). Some studies reported high retention rates, however, the percentage of participants that completed both pre- and post-intervention assessments (25 %; Young and Janke, 2013) or attended intervention activities (21 %; de Souza and Grundy, 2007) was sometimes low.

Overall, RCTs provided no description of the method used to generate the sequence of randomisation and whether outcome assessors were blinded to the intervention (Table 1). Many non-randomised controlled studies did not formally consider or account for confounding variables in their design and analysis, such as age, gender, education level, or health and socioeconomic status. Note, occasionally authors stated that a significant effect was found on an outcome, but the *p*-value reported was greater than the standard significance level (.05). In these instances, in this review we report the effect as not significant. Considering qualitative research, all studies used methods that were consistent with fulfilling their aims. However, some of them lacked an adequate description of data collection (Barnard, 2014; Santini et al., 2018), and interpretation of results was not always sufficiently substantiated by the data included (Barnard, 2014).

3.7. Cognitive outcomes

Of the 44 studies included in the analysis, eight examined cognitive outcomes (see Table 3). Three of the studies were RCTs (Carlson et al., 2008, 2009; Fried et al., 2004; Parisi et al., 2015), two were non-randomised controlled trials (Sakurai et al., 2016, 2018), and three were pre- and post-intervention studies (Lee and Kim, 2019; Newman et al., 1995; Young and Janke, 2013).

Sakurai et al. (2018) reported no significant time x group interaction on global cognitive functioning (i.e. MMSE score; Folstein et al., 1975) after 6 years of exposure to IE. However, Sakurai et al. (2016) assessed impacts on overall intellectual functional capacity using the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC; Koyano et al., 1991) and found that, after 7 years of exposure, the control group had higher odds of intellectual impairment than the intervention group. The majority of the more specific cognitive outcomes were grouped into psycho-motor speed, memory, and executive function.

3.7.1. Psycho-motor speed

In two studies, measures of psycho-motor speed were included: the Trail-Making Test-A (TMT-A) and Digit Symbol Coding (Carlson et al., 2008; Sakurai et al., 2018). No significant intervention effects were reported on these measures.

Table 2
Characteristics and aims of the studies included in the review.

Study	Country	Sample Size[a]	Participants			Age (Years)		Gender (%)		Design	Duration	Dosage	Aims
			Control	IE 1	IE 2	*M*(SD)	Range	Women	Men				
Adam, J.E. (1992)	USA	34	–	34	–	83.3	51–100	79	21	pre-and post-uncontrolled study	1 school year	2 or more sessions per month (session duration not specified)	To assess the effect of increased contact with children on the wellbeing of nursing home residents.
Alcock, C.L. et al. (2011)	UK	13	–	13	–	–	65–80	77	23	focused ethnographic evaluation	7 months	36 × 90 min sessions (weekly engagement not specified)	To promote social inclusion and mental wellbeing.
Barbosa, M. R., et al. (2020)	PORTUGAL	12	6	6	–	80.5 (IE) 87 (Control)	72–90	83	17	pre- and post-controlled study with a qualitative component	1 year	1 x 2 h per month	To assess the effects of intergenerational relationships on the self-esteem, loneliness, depression, and happiness of institutionalised older adults (OAs).
Barnard, D. (2014)	AUSTRALIA	8	–	8	–	–	88–95	25	75	pre- and post-qualitative survey	3 months	1 h per week	To enhance a sense of personal well-being and increase understanding and collaboration between the two generations.
Belgrave, M.J. and Keown, D.J. (2018)	USA	18	–	18	–	69.29 (5.49)	61–79	72	28	pre- and post-uncontrolled study with a qualitative component	4 weeks	2 virtual exchanges (one session per week; no real-time streaming); half day 'live' workshop collaboration and a joint performance (session duration not specified)	To examine changes in cross-age comfort, expectations after experiencing "virtual" exchanges, and preconceived notions of younger persons enrolled in a distance-based intergenerational project.
Carlson, M.C., et al. (2008); Fried et al. (2004); Tan, E. J., et al. (2006)	USA	128	58	70	–	–	60-68	83	17	RCT	1 school year	15 h per week (3-4 days per week)	To examine the impacts of the Experience Corps programme on physical, social, and cognitive functioning/activity.
Carlson, M.C., et al. (2009)	USA	17	9	8	–	67.89 (4.4)	60+	100	–	RCT	6 months	15 h per week (3–4 days per week)	To assess the effects of the Experience Corps programme on brain plasticity in age-vulnerable cognitive functions among cognitively at-risk OAs.
Carstensen, L., et al. (1982)	USA	23	12	11	–	72 (5.6)	–	87	13	non-randomised controlled trial	2 months	15 min. per day (4 days per week)	To examine morale among older adult tutors.
Chapman, N. J. and Neal, M. B. (1990)	USA	107	–	25	82	73	53–92	80	20	pre-and post-uncontrolled study with a qualitative component	6 months	3–4 h per week	To investigate a) attitudes and behavioural intentions toward the other generation, and b) assumptions underlying intergenerational programming.
Chippendale, T. and Boltz, M. (2015)	USA	39	16	23	–	76.83 (9.7)	60+	90	10	RCT with a qualitative component	4 weeks	1 × 90 min. per week	To investigate the therapeutic benefits of life review writing plus intergenerational exchange.

(*continued on next page*)

Table 2 (*continued*)

Study	Country	Sample Size[a]	Participants			Age (Years)		Gender (%)		Design	Duration	Dosage	Aims
			Control	IE 1	IE 2	*M*(SD)	Range	Women	Men				
Chung, S. and Kim, J. (2020)	KOREA	34	–	34	–	72.1 (5.5)	60+	32.4	67.6	pre- and post-uncontrolled study	4 months	8 x 2 h session (weekly engagement not specified)	To examine whether the programme increases intergenerational solidarity and positive perceptions toward the younger generation.
de Souza, E. M. and Grundy, E. (2007)	BRAZIL	266	117	149	–	69.5 (6.8)	60+	60.5	39.5	RCT	4 months	1 x 2 h per week	To assess the cognitive components of social capital and self-rated health.
DeMichelis, C. et al. (2015)	CANADA	10	–	10	–	72 (7.6)	60–89	–	–	pre-and post-uncontrolled study with a qualitative component	3 weeks	1 x 1.5 h per week	To assess development of psychological wisdom.
Ehlman, K., et al. (2014)	USA	124	–	124	–	78.4 (5.8)	65+	75	25	pre-and post-uncontrolled study	2–3 weeks	1 × 1 h per week	To assess perceived levels of generativity.
Fujiwara, Y., et al. (2009)	JAPAN	141	74	67	–	68.45 (5.4)	60–69	73.27	26.73	non-randomised controlled trial	18 months	1 session per 1–2 weeks; reading and playing for 30 min. per class (kindergarten); reading picture books for 15 min. per class (elementary school)	To examine the effects of the REPRINTS intervention on older adult volunteers' physical health, subjective and psychological health, social participation, social network, social support, and cognitive function.
Gaggioli, A., et al. (2014)	ITALY	32	–	32	–	67.53 (6.0)	–	–	–	pre-and post-uncontrolled study	3 weeks	3 x 2 h per week	To investigate effects of an intergenerational reminiscence group on OAs' perceived levels of loneliness, self-esteem, and quality of life.
Gamliel, T. and Gabay, N. (2014)	ISRAEL	29	–	29	–	–	66–77	–	–	pre-and post-uncontrolled study with a qualitative component	8 months	1 x 2 h per week	To explore empowerment in each generational group and the social relations between groups.
Gruenewald, T., et al. (2016); Parisi, et al. (2015)	USA	702	350	352	–	67.4 (5.9)	60–89	85	15	RCT	2 years	15 h per week (3–4 days per week)	To examine the impact of the Experience Corps programme on OAs' self-perceptions of generativity and daily lifestyle activities.
Halpin, S. N., et al. (2017)	USA	147	–	147	–	77.6	64–99	64.4	35.6	pre-and post-uncontrolled study with a qualitative component	11 months	1 session per month (session duration not specified)	To examine the impact of mentoring health professions students on OAs' mental, physical, and emotional health.
Hernandez, C. R. and Gonzalez, M.Z. (2008)	SPAIN	103	32	36	35	75 (6.0)	65+	83.5	16.5	non-randomised controlled trial	8 months	1 × 60 min. per week	To assess impacts on stereotyped attitudes towards OAs' and on OAs'' wellbeing.

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Table 2 (*continued*)

Study	Country	Sample Size[a]	Participants			Age (Years)		Gender (%)		Design	Duration	Dosage	Aims
			Control	IE 1	IE 2	*M*(SD)	Range	Women	Men				
Hsu, S., et al. (2014)	TAIWAN	118	63	55	–	70.75 (6.9)	60–92	71.2	29.8	non-randomised controlled trial	8 weeks	1 × 90 min. per week	To assess the impact on mutual understanding and inclusion between generations, and on OAs 'physical and mental health.
Johnson, W. (2014)	USA	20	–	20	–	68.88	65–76	68.75	31.25	pre-and post-uncontrolled study with a qualitative component	8 weeks (6 weeks IE contact)	1 x 2 h per week	To explore the effects of an intervention in which OAs learned digital communication technologies from older adolescents, and its effects on OAs' life quality and satisfaction.
June A. and Andreoletti C. (2020)	USA	16	–	16	–	85.2 (9.4)	60–100	68.8	31.2	pre- and post-uncontrolled study	1 college semester	6 × 1 h sessions (weekly frequency of intergenerational engagement not specified)	To determine whether older adults would experience increased feelings of generativity after participation in a few meaningful intergenerational interactions.
Kamei, T., et al. (2011)	JAPAN	22	8	14	–	72.1 (7.95)	–	100		non-randomised controlled trial with a qualitative component	6 months	3 h per week (2.5 h spent with children; 22 sessions total)	To examine the progression of intergenerational interactions among and between OAs and children and to evaluate the OAs' health-related quality of life (HRQOL) and depressive symptoms.
Lee, O.E.-K. and Kim, D.-H. (2019)	USA	55	–	55	–	73.82 (12.30)	–	63.6	36.4	pre- and post-uncontrolled study with a qualitative component	Not specified	6 × 1 h sessions (weekly frequency of intergenerational engagement not specified). A total of 276 mentoring hours was provided.	To examine the effect of the Intergenerational Mentor-Up programme on older adults' experience of social isolation.
Lin, Y.-C., et al. (2017)	TAIWAN	9	–	9	–	69.33 (5.27)	65–80	77.8	22.2	pre- and post-uncontrolled action research project with a qualitative component	12 weeks	1 x 2 h per week	To develop and evaluate the effectiveness of an intergenerational health promotion programme.
Mahoney, N., et al. (2020)	AUSTRALIA	15	–	15	–	74 (Median)	50–81	–	100	pre- and post-uncontrolled study with a qualitative component	6 months	1 × 3–5 h per week	To investigate the experiences of older male mentors involved in an intergenerational programme with young men with intellectual disability and identify any benefits to physical and mental health and generativity.

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Table 2 (*continued*)

Study	Country	Sample Size[a]	Participants			Age (Years)		Gender (%)		Design	Duration	Dosage	Aims
			Control	IE 1	IE 2	*M*(SD)	Range	Women	Men				
Meshel, D.S. and McGlynn, R.P. (2004)	USA	21	–	21	–	–	60–75	70.6	29.4	pre-and post-uncontrolled study	6 weeks	1 × 1 h per week	To promote positive cross-generational attitudes.
Murayama, Y., et al. (2015)	JAPAN	136	82	54	–	69.1	65–79	83.8	16.2	non-randomised controlled trial	2 years	1 session per 1−2 weeks; reading and playing for 30 min. per class (kindergarten); reading picture books for 15 min. per class (elementary school)	To assess effects of the REPRINTS intervention on OAs' depressive symptoms and their sense of coherence.
Newman, S., et al. (1995)	USA	26	–	26	–	–	60+	84.62	15.38	pre-and post-uncontrolled study with further follow-up	6 months	A minimum of 1 x 3 h week	To examine OAs' everyday memory performance and perceptions of their memory performance as a result of a weekly intergenerational school programme.
Perry, C. K. and Weatherby, K. (2011)	USA	10	–	10	–	70 (8.0)	–	85.7	14.3	pre-and post-uncontrolled participatory research study with a qualitative component	8 weeks	1 × 1 h per week	To assess the feasibility and efficacy of increasing physical activity and social interaction among OAs and youths through an intergenerational physical activity programme.
Pinquart, R., et al. (2000)	USA	20	8 to 10	8 to 10	–	71.7 (8.3)	–	100	–	non-randomised controlled trial	6 weeks	1 x 1.5 h per week	To investigate intergenerational attitudes in children and OAs.
Posada, M.M. (2006)	USA	20 (14 cognitively intact)	9 (6 cognitively intact)	11 (8 cognitively intact)	–	84.7 (11.06)	57–98	75	25	non-randomised controlled trial	9 weeks	10 min per day (3 days per week)	To examine effects of interactions between children and nursing home residents on depression and positive behaviours of residents.
Sakurai, R., et al. (2016)	JAPAN	349	186	163	–	67.1 (5.2)	–	80.2	19.8	non-randomised controlled trial	7 years	1 session per 1−2 weeks	To investigate the long-term effects of REPRINTS, focusing on functional capacity and physical function.
Sakurai, R., et al. (2018)	JAPAN	118	62	56	–	68.2 (5.6)	–	82.4	17.6	non-randomised controlled trial	6 years	1 session per 1−2 weeks	To examine the effects of REPRINTS intervention on age-related hippocampal atrophy.
Sanders, M.J., et al. (2013)	USA	92	–	92	–	74.42	57–89	75.8	24.2	pre-and post-uncontrolled study	4 weeks	1 × 1 h per week	To determine the impacts of a client-centred computer programme on computer skills and generativity in novice OA computer users, using a community-based participatory research approach.

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Table 2 (*continued*)

Study	Country	Sample Size[a]	Participants			Age (Years)		Gender (%)		Design	Duration	Dosage	Aims
			Control	IE 1	IE 2	*M*(SD)	Range	Women	Men				
Santini, S., et al. (2018)	ITALY	16	–	16	–	83	–	68.8	31.2	pre- and post-participatory qualitative study	8 months	1 x 2 h session per 10 days (25 sessions of IE)	To promote institutionalised OA's social inclusion, emotional well-being, and relational capabilities.
Sng, J.R.H. and Jung, Y. (2020)	SINGAPORE	50	–	50	–	71.9	–	80	20	Pre- and post-uncontrolled study	3 weeks	3 × 30 min. sessions (1 session per week)	To explore the effects of intergenerational video gameplay intervention on intergroup anxiety and improved intergenerational attitudes.
Strand, K.A., et al. (2014)	USA	68	–	68	–	–	60+	87	13	pre-and post-uncontrolled study with a qualitative component	8 weeks (programme = 25 weeks; 8 weeks were interactive)	2 × 60 min. per week	To examine effects of combining three health promotion approaches of intergenerational group design, exergaming, and theory-based wellness newsletters on OAs' physical activity participation and subjective health.
Sun, Q., et al. (2019)	Hong Kong	150	77	73	–	72.54 (7.18; IE); 73.95 (8.7; Controls)	–	80.82 (IE); 79.22 (Controls)	19.18 (IE); 20.78 (Controls)	pre- and post-non-randomised controlled trial	6 weeks (4 weeks were interactive)	2 × 2 h sessions (no IE); 2 × 7.5 h IE sessions; 2 × 2 h IE sessions (19 h of intergenerational interaction)	To evaluate the effectiveness of the YOLG programme on intergenerational attitudes and perceptions, sense of comfort with cross-age groups, and intergenerational interaction.
Tan, E.J., et al. (2009)	USA	420	336	84	–	72.1 (4.35)	65–86	100	–	non-randomised controlled trial	3 years	15 h per week (3–4 days/week)	To assess longer-term effects of the Experience Corps programme on physical activity.
Wilson, N.J., et al. (2013)	AUSTRALIA	6	–	6	–	–	60–75	–	100	qualitative study	6 weeks	1 session per week (session duration not specified)	To investigate mentors' experiences and views about the youths, the structure of the program, and the role of meaningful occupation.
Xu, X., et al. (2016)	SINGAPORE	89	63	26	–	75	60+	77	23	non-randomised controlled trial	1 week	3 × 35–40 mins per week	To examine effects of exergaming on OAs' social anxiousness, sociability, and loneliness.
Young, T.L. and Janke, M.C. (2013)	USA	197	–	197 (48 completed pre-and post-tests)	–	–	50–89	78	22	pre-and post-uncontrolled study	5-year initiative, but data collected over ~1.5 years	Not specified	To examine OAs' perceived benefits and concerns in a community-based intergenerational programme.

[a] Baseline sample of older adults only. Reported sample is the number of participants who passed the initial screening and were included in the study. IE = Intergenerational Engagement.

3.7.2. Memory

All three studies that reported memory outcomes included objective memory performance measures on immediate and delayed recall. One of them observed a significant intervention effect on both immediate and delayed verbal (and not visuo-spatial) recall at the 8-month post-test, but only in the subgroup of participants who had impaired executive functioning at baseline and not when considering the full sample (Carlson et al., 2008; Table 3). Sakurai et al. (2018) found no significant effects on either verbal or visuo-spatial memory. Newman et al. (1995) reported variable directionality of changes in objective memory performance (visuo-spatial memory), with a decrease in performance at the 6-month test and an increase at the 8-month follow-up (as compared to the baseline; Newman et al., 1995). However, Newman et al.'s (1995) results were not subject to statistical testing and so cannot be considered reliable.

3.7.3. Executive function

In three studies, measures of executive functioning were included: the TMT-B which involves planning and shifting between stimulus categories (Carlson et al., 2008; Sakurai et al., 2018), the Flanker Test which is a test of inhibitory selective attention (Carlson et al., 2009), and verbal fluency which assesses organisation and recall of categories of words from long-term memory (Sakurai et al., 2018). On the Flanker Test, significant improvement (group x time interaction effect) was observed in interference and inhibition-related accuracy in a 6-month volunteer intervention (Carlson et al., 2009). In a separate study of the same volunteer intervention, an effect was also found on TMT-B following 8 months of exposure (Carlson et al., 2008), but only when the groups were stratified by baseline impairment in executive function. However, a long-term, six-year follow-up of another volunteer intervention revealed no interaction effect on the TMT-B or verbal fluency (phonemic or semantic categories; Sakurai et al., 2018).

3.7.4. Cognitive and lifestyle engagement

In a 6-month RCT, Fried et al. (2004) reported on lifestyle activities outside of the programme, including cognitive engagement, and observed significant effects on television viewing hours. Controls' viewing time increased while volunteers' time reduced slightly. There were no effects on time spent on other cognitively demanding activities (i.e. grouped as low-, moderate-, or high-intensity activities, and books read per month). In a larger RCT of this programme, Parisi et al. (2015) repeated the same questionnaire and stratified by intellectual (e.g. discussing local/national issues, reading a book, balancing a checkbook), creative (e.g. preparing food, sewing/mending/fixing things), and passive [watching TV, listening to music, listening to radio (not music)] domains of activity. Significant increases were found on intellectual activities at 12- and 24-month follow-ups, and in passive activities (specifically, regarding listening to music or the radio, as opposed to watching television) at 24-month follow-up (but not at 12 months) suggesting a duration-dependent benefit of IE volunteering.

Young and Janke (2013) observed no intervention effect (i.e. effect of time) on perceived knowledge and skills or perceived ability to carry out the IE activities. However, Lee and Kim (2019) reported qualitative findings indicating some gains in learning following exposure to an intergenerational mentoring programme. Based on the data derived from the post-programme interviews with older adult participants, the intervention allowed them to acquire new technological knowledge, learn new skills, and use these to explore various leisure activities.

3.7.5. Cognitive outcomes - summary

In summary, the reviewed studies generally provide limited support for the short-term, but not necessarily long-term, impacts of IE on specific components of cognition. In particular, two of the three studies on executive function observed short-term benefits across measures, but these were not evident when considering long-term exposure (Carlson et al., 2008, 2009; Sakurai et al., 2018). A reliable long-term effect of IE was however found for global intellectual capacity in one study (Sakurai et al., 2016). Time spent on intellectual and passive lifestyle activities may also benefit from IE, particularly with longer exposure (Fried et al. (2004; Parisi et al., 2015), and qualitative data showed perceived benefits for learning (Lee and Kim, 2019). Finally, no reliable effects were observed for psycho-motor speed, and memory outcomes exhibited only very limited effects (i.e. when the sample was stratified by initial ability; Carlson et al., 2008).

3.8. Health and wellbeing outcomes

Health-related outcomes were grouped into: mental health and quality of life; physical activity levels; and physical functioning. Most of the included studies used standardised scales, with only a few studies involving non-standardised measures for self-rated health (Fujiwara et al., 2009; Hsu et al., 2014; Young and Janke, 2013), intergroup anxiety (Sng and Jung, 2020), lifestyle activity (Parisi et al., 2015), and falls (Fried et al., 2004).

3.8.1. Mental health and quality of life

3.8.1.1. Depression and anxiety. Nine quantitative studies considered depression (six non-randomised controlled trials and three pre- and post-intervention studies). Four studies found that IE reduced depression scores: at the 3-month time point, but only in the more depressed older adult subgroup (Kamei et al., 2011); at 8-month post-intervention evaluation (Hernandez and Gonzalez, 2008); at 1-year post-test (Barbosa et al., 2020); and at 2-year post-test, mediated by the sense of meaningfulness scale (indirect effect; Murayama et al., 2015). One study showed a decrease of 16.6 % in perceived depression reported at the 8-month follow-up (Newman et al., 1995), inconsistent with a smaller increase at the 6-month post-test. Lack of statistical testing again reduces the quality of these latter findings. Four other studies reported no significant effect of IE on depression (Adam, 1992; Johnson, 2014; Posada, 2006; Sakurai et al., 2016). Three quantitative studies (one non-randomised controlled trial and two pre- and post-intervention studies) considered anxiety. All three showed a significant decline in intergroup anxiety (Sng and Jung, 2020), social anxiety (Xu et al., 2016) and anxiety regarding ageism (Halpin et al., 2017).

3.8.1.2. Quality of life. Out of four quantitative studies (one non-randomised controlled trial and three pre- and post-intervention studies) that considered quality of life, three showed a significant increase on a single subscale of the outcome over 3 weeks and 6 months of exposure. Gaggioli et al. (2014) showed an increase in the subscale of Past, Present and Future Activities of the World Health Organization Quality of Life Scale for Older People (World Health Organization Quality of Life Scale for Older People (WHOQOL-Group), 1995), which evaluates satisfaction about achievements in life and about things to look forward to. Kamei et al. (2011) and Mahoney et al. (2020) observed an increase in the mental health component of the Health-Related Quality of Life scale (HRQOL; Fukuhara and Suzukamo, 2004) and the 36-Item Short Form Health Survey (SF-36; Ware and Sherbourne, 1992), respectively. Five out of six subscales of the WHOQOL-Old and seven out of eight subscales of the HRQOL and SF-36 showed no significant changes (Gaggioli et al., 2014; Kamei et al., 2011; Mahoney et al., 2020). Finally, using the CASP-19 (Hyde et al., 2003), Johnson (2014) observed no effect of IE on overall quality of life.

3.8.1.3. Self-esteem/self-representation/empowerment. Four quantitative (two non-randomised controlled trials and two pre- and post-intervention studies) and three qualitative studies considered self-esteem or self-representation. All four quantitative studies (Barbosa et al., 2020; Chapman and Neal, 1990; Gaggioli et al., 2014; Sakurai et al., 2016) demonstrated no significant effect over 3 weeks – 7 years of exposure.

Table 3
Available evidence related to older adults' (OAs') social, physical health, and/or cognitive outcomes, organised by study type.

Study	Outcomes			Findings*
	Social	Health	Cognitive	
Quantitative **Randomised controlled trial**				
Carlson, M.C., et al. (2008) Fried L.P., et al. (2004) Tan, E.J., et al. (2006)	**Social Activity**: 1. Number of adults: a) One could turn to b) Who would check on you if sick c) One could depend on d) Seen in a typical week 2. Could have used more emotional support from other in the past year	**Physical Activity**: 1. More active at follow-up 2. Number of blocks walked/week 3. Proportion walking no blocks/week 4. Flights of stairs climbed/week 5. Proportion climbing no stairs/week 6. Activity in kilocalories/week 7. Number of hours lying down or sitting while awake 8. Intermediate outcomes a) Strength - very good/excellent (% reporting) - feel stronger at follow-up (% reporting) b) Fallen in the past 12 months (% reporting) c) Cane use (% reporting less often) d) Walking speed (m/s) 9. Physical activity/week (mins) 10. Physical activity/week (kcals) 11. Walking for exercise/week (kcals) 12. Household chores/week (kcals) 13. Exercise/week (kcals) 14. Leisure activity/week (kcals) 15. Percentage who are active 16. Self-reported increased physical activity at follow-up relative to baseline (percentage of participants reporting an increase)	**Psycho-motor speed** (Trail-Making Test Part A; TMT-A; Reitan, 1958) **Executive function** (TMT-B) **Verbal memory** (word list memory; immediate and delayed) **Visuo-spatial EF and memory** (Rey-Osterrieth Complex Figure Test; Lezak, 1995; copy and delayed recall) **Cognitive Activity**: 1. Summed outside of programme activities: a) high-intensity activities (e.g., crossword puzzles) b) moderate-intensity activities (e.g., cooking) c) low-intensity activities (e.g., TV viewing) d) books read/month e) hours of television/day	**Social outcomes:** *A significant main effect of intervention group* was found on change in the number of people that participants felt they could turn to for help (intervention = 5.3 at baseline to 6.2 at follow-up; control 5.8 to 4.3; $p = .03$); *No significant effect* was found on the remaining social outcomes (all $p > .20$). **Health outcomes:** *A significant main effect of intervention group* was found on: (1) self-reported increased physical activity (63 % of participants in the intervention group vs 43 % in the control group; $p = .04$); (2) change in self-reported strength very good or excellent (an increase from 48 to 65 % in the intervention group vs a decline from 52 to 36 % in the control group; $p < .03$); (3) % participants reporting feeling stronger (intervention = 44 % vs control = 18 %; $p < .02$); (4) walking speed (a decrease from 0.95 to 0.92 in the intervention group vs a decrease from 1.06 to 0.86 in controls; $p = .001$); (5) change in household chores per week (intervention = 120–240 vs control = 100–110 kcals; $p = .02$, unadjusted; $p = .07$, when adjusted for age, gender, race, education, and health status); (6) self-reported increased physical activity (intervention = 53 % vs control = 23 %; $p < .01$). *No significant overall intervention effects* for changes in (1) physical activity in mins; (2) physical activity in kcals; (3) walking in kcals; (4) exercise; (5) leisure activity; (6) percentage who are active; (7) walking (blocks/wk); or (8) stairs climbed (all $p > .17$). Participants were also stratified by baseline physical activity, with 'active' defined as reporting at least 10 episodes in the last 2 weeks of moderate activity of at least 30 min. duration, and 'low activity' defined as those with less activity than this. In the low activity group, *significant intervention effects* were found for: (1) change in physical activity (kcals/wk: intervention = 420–880 vs control = 490–500; $p = .01$; and mins/wk: intervention = 120–210 vs control = 120–130; $p = .02$); (2) change in household chores per week (kcals: intervention = 70–240 vs control = 90–110; $p < .01$); (3) self-reported increased physical activity (intervention = 49 % vs control = 18 %; $p < .01$, unadjusted; $p = .05$, adjusted). *No significant effects* were found on the remaining variables for 'low activity' group (all $p > .72$). In the 'active' group, *a significant intervention effect* was observed for percentage who are active (intervention = 100 to 65% vs control = 100 to 20%; $p = .02$, unadjusted; $p = .17$, adjusted). *No significant effects* observed for any of the remaining variables for the 'active' group (all $p > .16$). *No significant intervention effect* was found on the remaining physical outcomes (all $p > .13$).

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Table 3 (*continued*)

Study	Outcomes			Findings*
	Social	Health	Cognitive	
				Cognitive outcomes: When the whole sample was analysed, *no significant effects of intervention group* were found on: (1) TMT-A; (2) TMT-B; (3) immediate word recall; (4) delayed word recall; (5) Rey-Osterrieth copy; or (6) Rey-Osterrieth delayed recall (all $p > .05$). When participants were stratified by presence or absence of baseline EF impairment (presence defined as TMT-B performance in the poorest tertile, > 203 s) *a significant effect* of intervention group was found on: (1) TMT-B (a 'clinically significant improvement' from 298 to 173 s in the EF-impaired intervention subgroup vs a decline from 260 to 237 s in the EF-impaired controls; $p < .05$); (2) immediate word recall (an increase from 19.3–20.9 in the EF-impaired intervention subgroup vs a decrease from 21.6–19.6 in the corresponding controls; $p < .05$); (3) delayed word recall (an increase from 5.0–7.0 in the EF-impaired intervention subgroup vs a decline from 6.4–5.6 in the corresponding controls; $p < .05$); *No significant effects* on: (1) TMT-A; (2) Rey-Osterrieth-copy; or (3) Rey-Osterrieth-recall (all $p > .05$). *A significant main effect of intervention group* was found on change in time viewing television (intervention group's score changed from 4.6 to 4.4 vs 4.5–5.3 in controls; $p = .02$). *No significant main effects* found on other outside-of-programme cognitive activities (all $p > .43$).
Carlson, M.C., et al. (2009)			**Executive function** (selective attention and inhibition using the Flanker Task)	*A significant group × time interaction effect* on: - RT-based interference scores ($p < .04$). Reduced interference from baseline to follow-up was observed for the intervention group compared to matched controls. Cue size (large/small) did not interact with this ($p < .20$ for the 3-way interaction). *A significant time x group x congruency effect* was found on: - accuracy ($p < .03$). Greater improvements from baseline to follow-up in the intervention group for 'incongruent' trials (i.e. containing interference; $p < .05$). Again, this was independent of cue size ($p < .16$ for the 4-way interaction).
Chippendale, T. and Boltz, M. (2015)	**Cross-age perceptions and generativity** (qualitative component; written description of IE)	**Sense of purpose and meaning in life** (the Meaning in Life Questionnaire- Presence; Steger et al., 2006) Mental wellbeing (qualitative component; written description of IE)		*A significant main effect of intervention group* was found on change in sense of purpose and meaning in life score (control = -3.5; intervention = 1.04; $p < .01$; Cohen's $d = 1.24$); Qualitative data revealed that intergenerational engagement (IE) was a positive experience in terms of: (1) enhancing positive views of younger generation; (2) allowing participants to share experiences and learn from each other; (3) promoting wellbeing (e.g. cognitive stimulation, positive mood); and (4) providing a supportive environment of value (e.g., safe social space).

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Table 3 (*continued*)

Study	Outcomes			Findings*
	Social	Health	Cognitive	
de Souza, E. M. and Grundy, E. (2007)	**Social functioning** (questionnaires derived from the American General Social Survey; Kawachi, 1999; and the health survey for England; Bajekal and Purdon, 2001): a) People can be trusted b) Neighbours are helpful c) People are honest d) People take advantage e) People are helpful f) People are selfish g) Family relationship improvement h) Quality of family relationship i) Trust in family	**Self-rated health status** (derived from the Brazilian Old Age Scale; Veras, 1992)		Using Intention to Treat (ITT) analyses on follow-up data from control and intervention participants, *significant positive effects of intervention group* were found on self-reports of: (1) neighbours' helpfulness ($p = .007$); (2) the honesty of most people in general ($p = .008$); (3) quality of family relationships ($p = .014$; however, *not significant* using 'as per protocol' analyses, $p = .09$). *No significant intervention effect* was found on participants' self-reports of: (1) improvement in their family relationships ($p = .27$); (2) the trustworthiness of most people in general ($p = .82$); (3) trust in family ($p = .85$); (4) people's selfishness (p-value not specified); (5) people take advantage' ($p = .27$); (6) people's helpfulness (p-value not specified); or (7) health status ($p = .55$)
Gruenewald, T., et al. (2016) Parisi, J.M., et al. (2015)	**Generativity** (a self-developed measure): a) generative desire (e.g. 'I want to give back to my community') b) generative achievement (e.g. 'I feel like I am giving back'). **Social activity** (Lifestyle Activity Questionnaire, LAQ; Carlson et al., 2012)	**Physical and passive activities** (Lifestyle Activity Questionnaire; Carlson et al., 2012)	**Intellectual and creative activities** (Lifestyle Activity Questionnaire; Carlson et al., 2012)	*A significant effect of intervention group* was found on: (1) generative desire at the 4-month ($p < .05$; Cohen's $d = .18$), 12-month ($p < .05$; $d = .17$), and 24-month ($p < .001$; $d = .26$) follow-up; (2) perceptions of generative achievement at the 4-month ($p < .001$; $d = .29$), 12-month ($p < .05$; $d = .19$), and 24-month ($p < .05$; $d = .16$) follow-up; (3) overall activity level at the 12-month follow-up ($p < .05$; but not at 24 months); (4) intellectual activity at the 12-month follow-up ($p < .05$) and at 24 months [$p < .05$; but only on Complier Average Causal Effect (CACE) Modelling, which takes adherence into account, and not ITT analysis which is more conservative]; (5) social activity at 12-month follow-up ($p < .05$; but only on the CACE model, and not at 24 months); (6) physical activity at the 12-month follow-up ($p < .05$; but not at 24 months); (7) passive activity at the 24-month follow-up only ($p < .05$; and only on the CACE Model). *No intervention effect* on creative activity ($p > .05$). Effect size estimates as a function of intervention exposure also suggested a *dose-response relationship* regarding generativity.
Non-randomised controlled trial				
Barbosa, M.R., et al. (2020)	**Qualitative findings** (focus groups): 1) community involvement; 2) intergenerational sharing.	**Self-esteem** (Rosenberg Self-esteem Scale; Rosenberg, 1965); **Happiness** (Subjective Happiness Scale; Lyubomirsky and Lepper, 1999); **Depression** (Geriatric Depression Scale; Yesavage, 1983); **Loneliness** (The UCLA Loneliness Scale; Russell et al., 1988); Qualitative findings (focus groups): 1)Wellbeing and positive emotions; 2) Purpose/meaning for older adults		*A significant effect of group* was found on change in depression ($p = .014$; $r = -0.714$). *No significant group effects* were found on the remaining health outcomes. However, large and medium effect sizes were reported for loneliness and happiness, respectively ($r = -0.51$; $r = -0.41$). Note, results were derived from non-parametric tests only. The authors state that the qualitative data showed that IE provided an opportunity for intergenerational sharing and community involvement, and positively impacted wellbeing and purpose/meaning in life. However, these categories are not sufficiently supported by the data as the focus group excerpts from the older

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Table 3 (*continued*)

Study	Outcomes			Findings*
	Social	Health	Cognitive	
				adults themselves are very limited and rarely reflect the highlighted categories.
Carstensen, L., et al. (1982)		**Life satisfaction** (Lohmann's Life Satisfaction Scale; Lohmann, 1980) **Purpose in life** (Purpose in Life Test; Frankl, 1960)		*No significant interaction effects* between intervention group and time were found on either measure (*p*-values not specified). Additional data from programme evaluation forms suggested some benefits of the intervention (i.e. 80 % of participants reported personally benefitting from participation; 70% reported feeling happier; and 70% reported feeling more in touch with the community).
Fujiwara, Y., et al. (2009)	**Social function** 1) Receiving social support (Noguchi's Index of Social Support; Noguchi, 1991): a) from family members living together b) from family members living apart c) from friends or neighbours. 2) Providing social support (Noguchi's Index of Social Support; Noguchi, 1991): a) to family members living together b) to family members living apart c) to friends or neighbours. 3) Social activity (a social activity checklist; Takahashi et al., 2000): a) social or volunteer activity b) individual activities c) lifelong study d) occupation (engaged in). 3) Social network(Noguchi's Index of Social Support; Noguchi, 1991): Frequency of communication with a) friends or neighbours b) grandchildren c) neighbourhood children d) distant children (outside of own neighbourhood) Number of persons a) friends or neighbours b) distant friends	**Self-rated health** **Physical function:** Hand grip strength (kg) Usual walking speed (m/min)		Using General Linear Modelling (adjusted for gender, age, and school years), *a significant intervention group × time* (baseline, 9-month follow-up) *interaction effect* was found on: (1) providing support to friends or neighbours ($p = .046$; intervention group score was 11.2 at baseline and 13.1 at follow-up; controls = 12.7 at both baseline and follow-up); (2) receiving support from friends and neighbours ($p = .038$; intervention group score = 9.9 at baseline, 8.8 at follow-up; control group = 10.5 at baseline, 11 at follow-up); (3) social networking with grandchildren ($p = .007$; intervention group score = 2.1 at baseline, 2.4 at follow-up; the control group = 2.7 at baseline, 2.4 at follow-up); (4) number of distant friends ($p = .044$; intervention group = 3.1 at baseline, 3.5 at follow-up; control group = 3.3 at baseline, 3.2 at follow-up); (5) frequency of contact with children outside their own neighbourhoods (through volunteer activity; $p < .001$; intervention group = 1.6 at baseline, 3.3 at follow-up; control group = 1.6 at baseline, 1.4 at follow-up); (6) occupation ($p < .001$; intervention group = 0.3 at baseline, 0.2 at follow-up; control group = 0.3 at baseline, 0.3 at follow-up). Note, however, no follow-up tests of the significance of any change within groups were reported. *No significant time x group interaction effect* was found on the remaining social outcomes (all p = n.s.). Using General Linear Modelling (adjusted as above), *a significant group × time interaction effect* was found on: (1) self-rated health ($p = .012$; intervention group score = 1.9 at baseline, 2.1 at follow-up; control group = 2.1 at baseline, 2.0 at follow-up); (2) hand grip strength ($p = .005$; intervention group score = 25.7 at baseline, 25.4 at follow-up; control group = 26.6 at baseline, 25.1 at follow-up). Again, no follow-up tests of the significance of any change within groups were reported. *No significant time x group interaction effect* was found on usual walking speed (p = n.s).
Hernandez, C.R. and Gonzalez, M. Z. (2008)	**Stereotyped perception of themselves** (negative old age stereotypes questionnaire; Montorio and Izal, 1991)	**Depression** (Geriatric Depression Scale; Yesavage, 1983)		No inferential analyses were conducted on the social measures. *A significant group x time interaction effect* was found on depression ($p < .0001$). There was a significant reduction of depressive symptoms in the intervention group (baseline = 15.15; follow-up = 11.62; $p < .001$), whereas an increase was observed in the control group (baseline = 12.12; follow-up = 14.94; $p < .001$).

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Study	Outcomes			Findings*
	Social	Health	Cognitive	
Hsu, S., et al. (2014)		**Perceived health status** **Emotional wellbeing** (Delighted-Terrible Faces Scale; Andrew and Withey, 1976) **Physical and mental functions** (short-form health survey (SF-12) with physical and mental components; Ware et al., 1996) **Happiness** (Chinese Happiness Index-Short Form; Lu, 1998)		*A significant main effect of intervention group* was found for the follow-up data on: (1) perceived health status ($p \leq .001$; control = 2.41; intervention = 3.13); (2) happiness ($p \leq .001$; control = 14.30; intervention = 17.76); (3) emotional well-being ($p \leq .001$; control = 5.14; intervention = 5.98). *No significant group differences* in the follow-up data for: (1) physical health component ($p = .07$); or (2) mental health component ($p = .05$). At baseline, *a significant group difference* only for perceived health status ($p = .042$; control = 2.48; intervention = 2.82; all other $p > .12$). *A significant main effect of time* within the experimental group was found for: (1) emotional well-being ($p \leq .001$); (2) happiness ($p = .007$). *No significant main effects* of time were found within the intervention group on: (1) mental health component ($p = .78$); and (2) physical health status ($p = .065$). There were *no significant effects* of time within the control group (all $p > .09$). Note, none of the analyses tested for interaction effects.
Kamei, T., et al. (2011)	**Qualitative findings** (interviews and observational field notes): a) Knowledge exchange b) Social interaction	**Health-related quality of life** (HRQOL; 8-item short form; Fukuhara and Suzukamo, 2004): a) general health b) physical functioning c) role physical d) bodily pain e) vitality f) social function g) mental health **Depression** (Geriatric Depression Scale-15; Niino, 1991)		*Main effect of time* was found in the OAs participating in the intervention on: (1) the mental health component of the HRQOL; $p = .03$, but not the other subscales (all $p > .10$). A significant improvement on mental health was found between baseline and after 6 months of involvement ($p < .05$; baseline = 48.3; 6-month follow-up = 53.3). (2) depression scores, but only in a subgroup of participants who scored ≥ 5 at baseline, the cut-off score for depression ($p = .045$; no significant effect in those scoring ≤ 4, $p = .46$). In those initially depressed, there was a significant decrease in depression at 3 months (baseline = 8.2; 3-month follow-up = 4.8). Note, none of the analyses tested for interaction effects. Qualitative data revealed that IE provided an opportunity to reminisce, to teach each other, and encouraged expansion of social interactions outside the programme.
Murayama, Y., et al. (2015)		**Sense of coherence** (the Japanese version of SOC-13; Togari and Yamazaki, 2005): a) comprehensibility b) manageability c) meaningfulness **Depression** (Geriatric Depression Scale-Short Version-Japanese; Niino, 1991)		*A significant group × time interaction effect* was found on: (1) sense of meaningfulness ($p = .017$). This increased in the intervention group from baseline (21.81) relative to all other follow-ups (3-months = 23.08; 1-yr = 23.62; 2-yrs = 23.69; $p < .05$), but there were no changes in the control group (*p*-values not reported). *No significant interaction effects* were found on the remaining outcomes (*p*-values not specified). There was a *significant mediated effect* of the intervention on depressive mood ($p = .023$), via sense of meaningfulness.

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Study	Outcomes			Findings*
	Social	Health	Cognitive	
Pinquart, R., et al. (2000)	**Cross-age attitudes** **Self-concept** (using a semantic differential scale; Caspi, 1984)			*A significant group x time* (pretest vs posttest vs follow-up) *interaction effect* was found on: (1) cross-age attitudes towards the children participating in the intervention ($p < .01$). Ratings of the children tended to increase in the intervention group from baseline to post-intervention testing (baseline = 3.69, post-testing = 3.99), whereas ratings from the control group tended to decrease (baseline = 4.11, posttest = 3.61). However, the *p*-value for this interaction involving only pretest vs posttest scores was not significant ($p < .06$). The interaction was also not significant when considering baseline vs the 7-week follow-up after the intervention completed ($p < .23$; follow-up score for intervention group = 3.75; control = 3.72). *No significant group x time interaction* was found for cross-age attitudes towards children in general or in OAs' self-concept (all $p >$ .44).
Posada, M.M. (2006)		**Depression** (Geriatric Depression Scale for 'cognitive intact' participants; Sheikh and Yesavage, 1986)		Using t-tests, *no significant main effect* of intervention group was found at time 3 (final follow-up) on depression scores for 'cognitively intact' (MMSE > 23) participants ($p > .05$; control = 2.83; intervention = 4.13; Cohens' $d = .56$). An ANOVA was also carried out, including the intervention group and time (baseline vs time 3) variables, but the main effect of intervention and the interaction effect were not reported.
Sakurai, R., et al. (2016)	**Social functional capacity** (Tokyo Metropolitan Institute of Gerontology Index of Competence; TMIG-IC; Koyano et al., 1991). Frequency of social interaction a) with friends (high/low) b) with children in the neighbourhood (high/low)	**Physical function**: a) grip strength (kg) b) comfortable gait speed (m/min) c) maximum gait speed (m/min) d) one-leg standing test (sec) e) functional reach (cm) f) Instrumental activities of daily living (IADL; TMIG-IC) g) frequency of going outdoors (high/low) h) subjective health (good/poor) **Psychological variables:** a) depression (Geriatric Depression Scale, GDS; Yesavage, 1988) b) self-esteem (Rosenberg Self-Esteem Scale; Mimura and Griffiths, 2007)	**Intellectual functional capacity** (TMIG-IC).	*A significant time* (baseline vs 7-yr follow-up) *x group interaction effect* was found on: (1) grip strength ($p = .035$); both groups declined at follow-up (all $p < .001$; control baseline = 26.2, control follow-up = 23.0; intervention baseline = 24.7, intervention follow-up = 22.9). (2) functional reach ($p = .048$); this decreased in the control group ($p < .001$; baseline = 38.5, follow-up = 34.7) and not in the intervention group (*p*-value reported as n.s.; baseline = 38.9, follow-up = 37.4). Functional reach was also higher in the intervention vs control group at follow-up ($p = .007$). *No significant time x group interaction effect* was found on: (1) depression; (2) self-esteem; (3) comfortable gait speed; (4) maximum gait speed; (5) one-leg standing test (all $p > .21$). Odds-ratios (OR) Logistic regression analyses (adjusted for sex, baseline age, education level, GDS scores, grip strength, and maximum walking speed), showed that the control group had higher odds for intellectual impairment [OR = 10.6; 95 % confidence interval (CI) = 1.64−68.6; $p = .013$], and for having fewer interactions with neighbourhood children (OR = 3.79; 95% CI = 1.60−9.00; $p = .003$). The intervention group had higher odds for going outdoors less frequently (OR = 0.36; 95% CI = 0.13−0.98; $p = .045$). There were no significant effects for: (1) social function; (2) frequency of interacting with friends; and (3) subjective health (all $p > .25$).

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Study	Outcomes			Findings*
	Social	Health	Cognitive	
				Note, IADL was not assessed due to no impairments existing at follow-up.
Sakurai, R., et al. (2018)		**Physical function**: a) grip strength (kg) b) usual gait velocity (m/s)	**Global cognitive functioning** (MMSE; Mori et al., 1985) **Immediate and delayed memory** (Rivermead Behavioral Memory Test; RBMT; Matsuda et al., 2002) **Psycho-motor/processing speed** a) TMT-A (Reitan, 1958) b) digital symbol (Wechsler Adult Intelligence Scale-R; WAIS-R; Wechsler, 1981) **Executive functioning** (TMT-B) **Verbal comprehension** (WAIS-R Information subtest) **Perceptual organisation** (WAIS-R Picture Completion subtest) **Verbal fluency:** a) phonemic b) semantic	*No significant group x time* (baseline vs 6-yr follow-up) *interaction effects* were found on any of the variables (all $p > .063$).
Sun, Q., et al. (2019)	**Intergenerational attitudes** (The Age Group Evaluation and Description Scale; Knox et al., 1995) **Sense of comfort with cross-age groups** (COMFORT; single question measure) **Interpersonal behaviour** (behavioural observation tool; Belgrave, 2011)			*Significant group x time interaction effects* were found for: (1) intergenerational attitudes ($p < .001$; control pretest = 123.03, posttest = 124.26; intervention pretest = 120.88, posttest = 168.49); (2) sense of comfort with cross-age groups ($p < .01$; control pretest = 4.99, posttest = 4.92; intervention pretest = 5.00, posttest = 5.73). *Significant increases* were reported for intergenerational interaction behaviours, comparing sessions 2 vs 5: (1) visual attention to ($p < .05$; $d = .29$; pretest = .57, posttest = .70); (2) initiating conversation with ($p < .01$; $d = .46$; pretest = .24, posttest = .40); (3) touching the young participants ($p < .05$; $d = .30$; pretest = .00, posttest = .03). *No change* was observed for smiling, encouragement, or assistance (all $p > .05$).
Tan, E.J., et al. (2009)		**Physical activity**/week (mins, kcals) **Walking**/week (kcals) Household chores/week (kcals) **Leisure activity**/week (kcals) **Exercise**/week (kcals)		Using t-tests, at the 3-year follow-up, *a significant main effect of intervention group* reported only for walking ($p = .05$; control = 240, intervention = 371), and not for any of the remaining variables (all $p > .25$). An unadjusted regression model revealed *a significant increase* in overall physical activity (kcals/wk) over 3 years for the intervention group (575 kcals/wk at 36 months) vs controls (422; $p < .01$; $p = .04$ when adjusting for characteristics such as age and frailty). For subgroup activity analyses (i.e. walking, etc.) there were *no*

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Study	Outcomes			Findings*
	Social	Health	Cognitive	
				significant effects in either unadjusted or adjusted models (all $p >$ .06).
Xu, X., et al. (2016)	**Sociability** (Reynolds and Beatty, 1999)	**Social anxiousness** (The Interaction Anxiousness Scale; Leary, 1983) **Loneliness** (UCLA Loneliness Scale; Russell, 1996)		*A significant time* (pre- vs post-intervention*) x group* (play exergaming alone vs play with OAs vs play with youths) *interaction effect* was found on social anxiousness (p = .015). A decrease was found only in OAs who played with the youths (p = .014; baseline = 1.97, posttest = 1.66) and not for the other groups (all p > .11). *No significant interactions were* found on the remaining variables (all p > .12).
Pre- and post-intervention studies				
Adam, J.E. (1992)	**Self-concept** (semantic differential scale; Osgood et al., 1957)	**Life satisfaction** (Life Satisfaction Scale Index Z; Wood et al., 1969) **Depression** (Beck Depression Inventory; Beck, 1967)		*No significant differences* from pre- to post-intervention were found (all p > .42).
Belgrave, M.J. and Keown, D.J. (2018)	**Cross-age comfort** (a researcher-developed tool; single item measure) **Cross-age attitudes** (reflective journal) a)preconceived notions and expectations			*A significant increase* was found in cross-age comfort (p < .05; r = 0.46; pretest = 5.5, posttest = 6) Regarding cross-age attitudes, qualitative findings indicated that the programme enhanced OAs' positive views of children's attributes, skills, and knowledge.
Chapman, N.J. and Neal, M.B. (1990)	**Cross-age attitudes** (adapted from other studies semantic differential scale) **Social distance** (adapted from other studies social distance scale)	**Self-esteem** (Rosenberg Self-Esteem Scale; Rosenberg, 1965)		*No significant change* from pre- to posttest on cross-age attitudes, social distance, self-esteem (p-values not specified).
Chung, S. and Kim, J. (2020)	**Intergenerational solidarity** (Choi, 2014, revised from European Commission, 2009) **Cross-age perceptions** (revised from Hong et al., 2014)			*No significant differences* between pre- and posttest on any of the 14 items in the intergenerational solidarity scale (all p > .05). *No significant differences* were found in OAs' perceptions of young adults across the 8 scale items, as well as regarding the combined positive, negative, and overall perceptions (all p > .05)
DeMichelis, C., et al. (2015)		**Wisdom** (Self-Assessed Wisdom Scale; Webster, 2003) **Life Satisfaction** (Temporal Satisfaction with Life Scale; Pavot et al., 1998)		*Significant decreases* were found in OAs' estimation of their own critical life experiences (p = .019) and humour (p = .031; note, scores not reported). *A significant increase* was found in their past-life satisfaction (p = .027) Note, remaining sub-scales/non-significant findings were not specified.
Ehlman, K., et al. (2014)	**Perceived generativity** (Loyola Generativity Scale; McAdams and de St. Aubin, 1992)			*A significant increase* was found on the generativity scale (p = .034; pretest = 40.23, posttest = 41.24). Note, there were *no significant effects* when considering either the past contributions or current generativity subscales (all p > .07).
Gaggioli, A., et al. (2014)		**Self-esteem** (an Italian version of the Rosenberg Self-Esteem Scale; Prezza et al., 1997) **Quality of life** (World Health Organization Quality of Life Scale for Older People (WHOQOL-Group), 1995): a) sensory abilities b) autonomy c) past, present and future activities (satisfaction with achievements/things to look forward to)		*Significant decreases* were found on: (1) general loneliness (p < .05; pretest = 1.88, posttest = 1.68); (2) emotional loneliness (p < .05; pretest = 1.76, posttest = 1.60). *A significant increase* was also found in the past, present and future activities subscale of quality of life (p = .05; pretest = 14.75, posttest = 15.40). *No significant effects* were found on the remaining measures (p-values not specified).

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Study	Outcomes			Findings*
	Social	Health	Cognitive	
		d) social participation e) death and dying (concerns, fears etc.) f) intimacy **Loneliness** (Italian Loneliness Scale; Zammuner, 2008): a) emotional loneliness b) social loneliness c) general loneliness		
Gamliel, T. and Gabay, N. (2014)	**Attitudes towards children** (self-developed scale): a) social distance subscale (closeness to children) **Knowledge exchange** (self-report): a) own learning skills b) own knowledge contribution c) children's teaching skills d) children's knowledge contribution	**Empowerment** (self-report): a) self-confidence b) communal involvement c) self-efficacy (New General Self Efficacy questionnaire; Chen et al., 2001)		*Significant increases* found in OAs': (1) closeness to children ($p < .001$, $r^2 = .77$; pretest = 1.80, posttest = 3.50); (2) assessment of children's teaching skills ($p < .05$, $r^2 = .08$; pretest = 3.92, posttest = 4.62); (3) assessment of children's knowledge contribution ($p < .001$, $r^2 = .26$; pretest = 3.80, posttest = 4.43); (4) self-confidence ($p < .001$, $r^2 = .22$; pretest = 3.47, posttest = 4.08); (5) communal involvement ($p < .001$, $r^2 = .26$; pretest = 2.30, posttest = 3.04); (6) self-efficacy ($p < .01$, $r^2 = .18$; pretest = 3.76, posttest = 4.21). *No significant effects* were found on the remaining measures (*p*-values not specified). Qualitative results supported quantitative findings by indicating that the programme brought children and OAs closer together and increased their confidence and competence. It helped them to cultivate constructive feelings of being valued, accepted, and respected.
Halpin, S.N., et al. (2017)	**Ageism** (modified Palmore, 2001)	**Ageism** (modified Age-Based Rejection Sensitivity Questionnaire; Kang and Chasteen, 2009): a) concern/anxiety b) expectations **Self-rated health status**: a) general health b) physical function c) physical role function d) emotional role function e) social role function f) bodily pain g) vitality h) mental health		*Significant decreases* were found over the 9-month programme in: (1) concern/anxiety over ageism ($p = .005$; pretest = 22.12, posttest = 19.47); (2) physical role functioning ($p = .033$; pretest = 76.24, posttest = 68.07); (3) social role functioning ($p = .004$; pretest = 91.58, posttest = 85.64); (4) mental health functioning ($p = .011$; pretest = 85.07, posttest = 82.09); Note, these reflect a positive change relative to ageism but declines for the functional measures (the programme duration was 9 months). *No significant effects* were found on the remaining variables (all $p > .13$). Thematic analysis of OAs' experiences of the programme highlighted one theme relevant to the current review: 'meaningfulness' (i.e. purposeful contact with young people which makes a helpful, enriching contribution, including breaking down stereotypes).
Johnson, W. (2014)	**Perceptions of/beliefs about ageing** (open-ended questionnaire and focus groups)	**Depression** (Geriatric Depression Scale; Sheikh and Yesavage, 1986) **Life satisfaction** (Life Satisfaction Index for the Third Age; Barrett and Murk, 2009) **Quality of life** (CASP-19; Hyde et al., 2003)		*No significant effects* were found for any of the health variables (*p*-values not specified). Qualitative analyses (pre- and post-intervention open-ended questions) showed a decrease in negative reactions regarding growing older and in perceived disadvantages of older age.

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Study	Outcomes			Findings*
	Social	Health	Cognitive	
June, A. and Andreoletti, C. (2020)	**Generativity** (The Loyola Generativity Scale; McAdams and de St. Aubin, 1992)			*A significant increase* was found on the generativity scale ($p = .014$; $d = .72$; pretest = 36.88, posttest = 44.06).
Lee, O. E.-K. and Kim, D.-H. (2019)	**Social isolation** (a perceived social isolation measure, Cornwell and Waite, 2009): a) perceived lack of social support b) loneliness **Communication** **Independent living** (qualitative component; interviews)		**Intergenerational learning** **Leisure activities** (qualitative component; interviews)	*A significant decrease* was found on the loneliness subscale ($p < .001$; pretest = 6.52, posttest = 4.26; $d = 1.45$) and on the overall social isolation measure ($p < .001$; pretest = 20.04, posttest = 17.04; $d = 0.74$), however perceived lack of social support did not significantly change ($p = .21$). Qualitative analysis showed that participating in the programme could promote intergenerational knowledge and skills exchange. Mutual learning served as a vehicle to connect generations, decrease the feeling of loneliness, and encouraged lifelong learning. The most commonly reported perceived positive change was using new knowledge to connect with family and to build a contact network. Learned skills also enhanced OAs' independence in daily activities and allowed them to explore online leisure activities.
Lin, Y.-C., et al. (2017)	**Attitudes towards ageing** (self-developed scale)	**Spiritual health** (self-developed scale)		*No significant effect* for attitudes towards ageing ($p = .55$). *A significant improvement* was found in spiritual health ($p = .049$; pretest = 66.33, posttest = 68.89).
Mahoney, N., et al. (2020)	**Generativity** (The Loyola Generativity Scale; McAdams and de St. Aubin, 1992) **Establishing relationships** (qualitative component; interviews)	**Quality of life** (SF-36 Version 2; Ware and Sherbourne, 1992): (1) Physical health summary: a) physical function b) role function c) bodily pain d) general health (2) Mental health summary: a) Vitality b) Social functioning c) Role emotional d) Mental health		*No significant effects* were found on the generativity scale ($p = .23$), physical health summary scale ($p = .86$), and mental health summary scale ($p = .15$). *No significant effects* for the vitality, social function, or role emotional subscales (all $p > .058$). For the mental health sub-scale, the scores were *significantly* higher at posttest (Mdn = 23) when compared with pretest (Mdn = 22; $p = 0.012$, $r = 0.47$). Qualitative evidence revealed that intergenerational mentoring could provide older men with an opportunity to exercise their generative desire to guide and help young generations and gain fulfilment for this desire. OA mentors reported that they were able to establish connection with their mentees via hands-on activities. Furthermore, IE led to mutual learning, developing communication skills, and learning new approaches and strategies to support young people with intellectual disability.
Meshel, D.S. and McGlynn, R.P. (2004)	**Cross-age attitudes** (self-developed semantic differential scale)	**Life satisfaction** (Satisfaction with Life Scale; Diener et al., 1985)		*Significantly more positive attitudes* towards younger people ($p < .01$; pretest = 5.32, posttest = 6.00). *A significant improvement* in life satisfaction ($p < .05$; pretest = 27.82, posttest = 29.00).
Newman, S., et al. (1995)		**Depression** (Geriatric Depression Scale; Yesavage, 1983)	**Objective memory performance** (Rivermead Behavioral Memory Test; Wilson et al., 1985) **Self-reported memory function** (Memory Functioning Questionnaire; Gilewski and Zelinski, 1986): a) retroactive memory b) mnemonic memory c) frequency of forgetting d) seriousness of forgetting	No inferential statistical analyses were carried out, and results took the form of outcome scores and percentage change only. Although the authors additionally stratified by age group and education, we note the percentage change scores for the whole sample (N = 26) only. (1) A + 5.08 % change in depression was reported at 6-months posttest (pretest = 5.71, posttest = 6.00) and a change of -16.64 % at the 8-month follow-up (4.76). Lower scores indicate lower levels of depression. (2) Objective memory performance changed by -.40 % at posttest (pretest = 20.23, posttest = 21.15) and by +6.97 % at follow-up (21.64).

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Table 3 (*continued*)

Study	Outcomes			Findings*
	Social	Health	Cognitive	
				(3) Retroactive memory changed by -.23 % at posttest (pretest = 17.73, posttest = 17.69) and -2.65 % at follow-up (17.26). (4) Mnemonic memory changed by -.81 % at posttest (pretest = 23.54, posttest = 23.35) and -4.89 % at follow-up (22.39). (5) Frequency of forgetting changed by -2.50 % at posttest (pretest = 164.50, posttest = 160.38) and +.41 % at follow-up (165.17). (6) Seriousness of forgetting changed by +2.19 % at posttest (pretest = 79.00, posttest = 80.73) and +6.33 % at follow-up (84.00). In all cases higher memory-related scores indicate higher functioning.
Perry, C. K. and Weatherby, K. (2011)		**Physical activity** (mins in previous 7 days; 7-Day Physical Activity Recall; Blair et al., 1985)		*No significant effect* on physical activity level ($p = .06$; scores not reported). Further qualitative data revealed that IE was a positive experience by: 1) being challenging mentally; 2) enhancing physical strength; 3) allowing learning of new skills; 4) encouraging physical activity; and 5) stimulating IE.
Sanders, M.J., et al. (2013)	**Generativity** (Loyola Generativity Scale; McAdams and de St. Aubin, 1992): a) passing knowledge to others b) feeling productive c) having important skills to teach d) being creative e) like to teach f) being a source of advice			*Significant increases* observed in OAs' feeling that they: (1) are productive ($p < .016$; pretest = 2.61, posttest = 3.10). (2) have important skills to teach others ($p < .002$; pretest = 2.09, posttest = 2.70) *No significant effects* were found on the remaining measures (all $p > .08$).
Sng, J.R.H. and Jung, Y. (2020)	**Outgroup (cross-age) attitudes** (Semantic differential scale; Meshel and McGlynn, 2004)	**Intergroup anxiety** (Chua et al., 2013)		*A significant effect of time was found* on outgroup attitudes ($p < .001$; pretest = 4.88, posttest = 5.87). *A significant decrease* was foundin intergroup anxiety($p < .013$; pretest = 2.01, posttest = 1.69).
Strand, K.A., et al. (2014)		**Physical activity** (Stages of Change for Physical Activity Questionnaire; Cancer Prevention Research Center, 2010) **Perceived physical health/wellness** (qualitative component; written evaluations)		A *significant increase* in self-reported physical activity amongst participants who were inactive at baseline ($p = .001$; 52.4% of participants who were inactive at baseline were active by week 25). *No significant effect* in the overall sample (*p*-value not specified). Qualitative analysis showed that the most commonly reported perceived positive change was participating in regular physical activity. Improved subjective health was the second most reported perceived positive change, and participants also frequently reported improvements in their level of pain.
Young, T.L. and Janke, M.C. (2013)	**Perceived benefits** (a researcher-developed tool): a) openness to ideas b) community Involvement c) interest in youths' education d) social life **Perceived Concerns:** a) youths' responsiveness b) ability to get along with youth c) school environment d) youths' behaviour	**Perceived benefits:** a) physical health b) mental health c) life satisfaction d) feeling about self e) energy level **Perceived concerns:** a) personal health	**Perceived benefits:** a) knowledge and skills **Perceived concerns:** a) ability to carry out activities	*No significant effects* of time on any of the perceived benefits or concerns (all $p > .05$). Post-programme, linear regression analyses *significantly predicted benefits* regarding: (1) community involvement ($p \leq .01$; the significant predictor was being involved in community improvement projects, $p \leq .05$); (2) social life ($p \leq .001$; significant predictors were being black/Hispanic, $p \leq .05$, male, $p \leq .05$, and involved in mentoring, $p \leq .01$, or community improvement projects, $p \leq .01$); (3) knowledge and skills ($p \leq .05$; significant predictorsˆ were being black/Hispanic, $p \leq .05$, male, $p \leq .05$, and a mentor, $p \leq .05$).

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Table 3 (*continued*)

Study	Outcomes			Findings*
	Social	Health	Cognitive	
	e) communication with teachers f) irregular youth attendance			Linear regression analyses *significantly predicted concerns/difficulties* regarding: (1) youths' responsiveness ($p \leq .05$; the significant predictor was being black/Hispanic, $p \leq .01$); (2) ability to get along with the youths ($p \leq .05$; the significant predictor was participating in a community programme, $p \leq .05$); (3) irregular youth attendance ($p \leq .05$; the significant predictor was not being married, $p \leq .05$). ˆNote, there is a discrepancy between the predictors of knowledge/ skills as stated in the text vs Table 4 in this paper. We have listed the results according to Table 4.
Qualitative				
Alcock, C.L., et al. (2011)	Themes (derived from focus groups and field notes): **Age-group stereotypes** **Intergenerational inclusion/ exclusion** **Sense of community**			(1) Reduced age-group stereotypes (e.g. coming to accept, learn from, and give to each other); (2) Many articulated a positive sense of community and companionship for older people.
Barnard, D. (2014)	Themes derived from programme survey: **Cross-age perception**	**Self-esteem Personal wellbeing**		(1) Residents' perceptions of the students were often positive at the outset, and perceptions were either validated or improved by participating in the program. (2) Residents demonstrated increased self-esteem and well-being in their written survey answers and observable responses throughout the programme (this point was not substantiated by the evidence included).
Santini, S., et al. (2018)	Themes derived from in-depth interviews: **Representation of young people (cross-age perceptions)** **Intergenerational relationships**	**Self-representation Mood**		(1) Residents' perceptions of the students were generally negative at the outset (e.g. 'egoists', 'dishonest'), but their attitudes substantially improved at the end of the programme (e.g. 'polite', 'kind'). The initial negative image of youth echoed in their mistrust of ability to establish relationships with the teenagers. The post-programme interviews revealed that IE boosted reciprocity and initiated close relationships between young and older people. (2) IE and increased closeness to the students helped the residents to improve their self-perceptions. At the beginning of the programme, OAs reported feeling physically inadequate and a sense of uselessness due to their age. Over the course of the programme, these negative self-representations changed to a sense of vitality and realisation of feelings and life experience to share with the younger generations. (3) Residents reported that the presence of students improved their mood and constituted a distraction from negative thoughts and health-related concerns.
Wilson, N. J., et al. (2013)	Themes derived from interviews and a focus group: **Cross-age perception** **Intergenerational exchange** **Generative desire**	**Sense of self**		Results showed that some groups of older retired men have an intrinsic desire to: a) support younger generations who are facing difficulty; and b) give something back to their communities. The mentoring project provided an opportunity: a) for older men to reconnect with the younger generation, and b) to adjust older men's roles, routines and occupations appeared to have a protective function for maintain a positive sense of self.

*p-values are as specified in the records.

Conversely, three qualitative studies suggested that IE enhanced self-esteem or sense of self-worth (Barnard, 2014; Santini et al., 2018; Wilson et al., 2013). In these studies, participants' excerpts revealed factors that might have led to improvements in their self-perception. These were: the opportunity to pass on knowledge to young people and to learn from them; the realisation of their emotional potential and self-worth; the genuine respect and interest shown by the younger generation; and feeling accepted, noticed, and valued. However, in Barnard's (2014) study, the conclusion that participants demonstrated increased self-esteem was not supported by data from their written survey or observable responses.

One quantitative (pre- and post-intervention) study examined empowerment, an outcome closely linked to self-esteem (Gamliel and Gabay, 2014). A positive effect of IE was found on all three subscales of the measure, including self-confidence, self-efficacy, and communal involvement.

3.8.1.4. Life satisfaction. Six quantitative studies (one non-randomised controlled trial and five pre- and post-intervention studies) measured life satisfaction over 3 weeks – 1.5 years of programme exposure. Two of these studies demonstrated significant improvements on either the whole life satisfaction scale (Satisfaction with Life Scale, Diener et al., 1985; Meshel and McGlynn, 2004) or the past-life subscale only (Temporal Satisfaction with Life Scale, Pavot et al., 1998; DeMichelis et al., 2015). The remaining four studies reported no reliable effects (Adam, 1992; Carstensen et al., 1982; Johnson, 2014; Young and Janke, 2013).

3.8.1.5. Purpose in life. Three studies (one non-randomised controlled trial and two mixed-method studies) considered sense of purpose in life. Chippendale and Boltz (2015) demonstrated significant positive effects of their 4-week intervention on change in sense of purpose and meaning in life. Conversely, Carstensen et al. (1982) reported no significant interaction between group and time on this outcome following 2-months' exposure. Qualitative findings on purpose in life were not substantiated with sufficient evidence (Barbosa et al., 2020).

3.8.1.6. Loneliness. Four quantitative studies (one non-randomised controlled trial, two mixed-method studies, and one pre- and post-intervention study) assessed loneliness. One of the studies considering loneliness as a component of the social isolation measure found a significant decrease on the outcome following the completion of the programme (Lee and Kim, 2019). Another one showed significant post-programme decreases in general and emotional loneliness, but not in social loneliness (Gaggioli et al., 2014). No significant main effects were found in the remaining studies (Barbosa et al., 2020; Xu et al., 2016).

3.8.1.7. Happiness. Three studies (two non-randomised controlled trials and one mixed-method study) examined happiness. Only one of these found a main effect of group at follow-up, with the intervention group feeling happier and controls reporting a decline in happiness over 8 weeks (Hsu et al., 2014). No significant intervention effects were found in two other studies (Barbosa et al., 2020; Carstensen et al., 1982).

3.8.1.8. Self-rated health and wellbeing. Seven quantitative studies (one RCT, two non-randomised controlled trials, three mixed-method studies, and one pre and post-test study) and two qualitative studies addressed self-reported health and wellbeing. Two non-randomised controlled trials and one pre- and post-intervention study showed significant improvements at 8-week (main effects of group on perceived health status and emotional wellbeing; Hsu et al., 2014) and 21-month follow-up (time x group interaction effect on self-rated health; Fujiwara et al., 2009). In three studies (de Souza and Grundy, 2007; Strand et al., 2014; Young and Janke, 2013) there were no significant intervention effects on self-reported physical or mental health, while one pre- and post- study (i.e. with no control comparison) showed a significant decline after 9 months on a mental health component of self-rated health (Halpin et al., 2017). Qualitative data from three other studies ranging in duration from 4 weeks to 8 months supplemented these findings, revealing positive effects of IE on wellbeing by providing cognitive stimulation and improving mood (Barnard, 2014; Chippendale and Boltz, 2015; Santini et al., 2018). However, the conclusion regarding improved wellbeing in one of the qualitative studies was not substantiated by the data included (Barnard, 2014).

3.8.2. Physical activity levels

Five studies (two RCTs, one non-randomised controlled trial, and two pre- and post-intervention studies) considered physical activity outcomes. Two studies demonstrated positive effects on overall physical activity levels at 4–8 month (Fried et al., 2004; Tan et al., 2006), and 3-year follow-ups (Tan et al., 2009). However, baseline physical activity levels moderated the results, with Tan et al. (2006) reporting significant overall change in physical activity only in those with low initial levels. One study also showed an improvement at 8 weeks in those with low baseline activity levels (Strand et al., 2014). Tan et al. (2006) additionally reported a positive intervention effect in the percentage of participants who remained active in their 'active' baseline group. On the other hand, Perry and Weatherby (2011) showed no significant increase in physical activity. However, qualitative data from this study revealed that many of the older adult participants felt that participating in an eight-week tai-chi class made them more comfortable and likely to be physically active. Finally, Parisi et al. (2015) considered the physical (three items: shopping, gardening, hunting/fishing/camping) domain of a lifestyle activity measure. They reported positive IE effects on physical activities after 12 months of exposure (but not 24 months).

3.8.3. Physical functioning

Three quantitative studies (one RCT and two non-randomised controlled trials) that assessed various aspects of physical functioning demonstrated significant positive effects of IE on: hand grip strength at 21-weeks and 7-years post-test (time x group interaction, with less decline in the intervention group; Fujiwara et al., 2009; Sakurai et al., 2016); self-reported strength and proportion of participants reporting feeling stronger, at 4–8 month follow-up (Fried et al., 2004); functional reach (time x group interaction, with the control group declining and the intervention group remaining stable; Sakurai et al., 2016); and walking speed (a smaller decline in intervention vs control; Fried et al., 2004). These results indicate positive effects of IE on some measures of physical functioning. However, Sakurai et al. (2016, 2018) and Fujiwara et al. (2009) did not report intervention effects on walking speed measures. The studies also reported no reliable effects on other aspects of physical function such as fall rates, cane use, or ability to stand on one leg (see Table 3).

3.8.4. Health and wellbeing outcomes – summary

In summary, this section covered a range of health and wellbeing outcomes. As the outcome measures varied across studies, this often prevented strong conclusions from being drawn. Additionally, where significant effects were occasionally observed for some outcomes (e.g. depression, quality of life, life satisfaction), this was only for a proportion of the available studies and/or for specific subscales. The most consistent improvements were, however, observed in relation to anxiety (Halpin et al., 2017; Sng and Jung, 2020; Xu et al., 2016) and physical activity levels (Fried et al., 2004; Tan et al., 2006, 2009; Strand et al., 2014).

3.9. Social outcomes

Social outcomes were grouped into: generativity; cross-age attitudes, comfort, and perceptions; and social interactions.

3.9.1. Generativity

Six quantitative (one RCT, two mixed-method studies, and three pre- and post-test studies) and two qualitative studies considered

generativity (i.e., nurturing and guiding younger generations). Four quantitative studies showed a positive effect of IE. These were observed for perceived generativity scores at 3-week follow-up (Ehlman et al., 2014), 4-week follow-up (Sanders et al., 2013), after one college semester of engagement (June and Andreoletti, 2020), and in both generative desire and perceptions of generative achievement at 4-, 12-, and 24-month exposure durations (Gruenewald et al., 2016). The latter also reported a dose-response relationship between intervention exposure and effect sizes on generativity. One mixed-methods study found no significant change from pre- to post-intervention on generativity (Mahoney et al., 2020). However, qualitative evidence derived from this study revealed that intergenerational mentoring enabled retired men to express generativity by helping young adults with intellectual disability. Moreover, other qualitative evidence indicated that older adults had an intrinsic desire to support younger generations who were facing difficulties (Wilson et al., 2013). Additionally, IE was seen to provide an opportunity to contribute positively to young people's lives, which gave a sense of achievement and pride (Alcock et al., 2011). Positive emotions experienced by older adults engaged in IE programmes were also associated with the opportunity to take on the position of mentor or role model (Chippendale and Boltz, 2015). The qualitative data illuminated participants' desire and enthusiasm to share experiences and knowledge with the younger generation (Chippendale and Boltz, 2015; Mahoney et al., 2020; Wilson et al., 2013). The effects of IE on self-perceived generativity therefore appear relatively consistent across the studies and methods used.

3.9.2. Cross-age attitudes, comfort, and perceptions

Nine quantitative studies (two non-randomised controlled trials, four mixed-method studies, three pre- and post-test studies) and two qualitative studies considered age-related attitudes. Two non-randomised controlled trials reported a positive group x time interaction effect on attitudes towards the younger generation participating in the intervention for baseline vs 6-week post-intervention (Sun et al., 2019) and baseline vs 6-week post-intervention vs 7-week follow-up (Pinquart et al., 2000). While ratings in the intervention group tended to increase at the post-test and that of the control group tended to decrease, the group x time (baseline vs post-test) interaction was not significant ($p <$ .06), as was the case for baseline vs follow-up ($p <$ .23), so these differences were not reliable (Pinquart et al., 2000). There was also no significant interaction on perceptions towards children in general (Pinquart et al., 2000). Two other studies found no significant change from pre- to post-intervention on cross-age attitudes, social distance, or enjoyment being with youths (Chapman and Neal, 1990), or on positive, negative, and overall cross-age perceptions (Chung and Kim, 2020). However, three other studies demonstrated increases in older adults' positive perception of the younger generation after a 3-week programme (Sng and Jung, 2020), 6-week programme (Meshel and McGlynn, 2004), and after one school semester of intervention (Gamliel and Gabay, 2014). Participation improved older adults' ratings of children's teaching skills and knowledge contribution, as well as increased feelings of closeness to the younger generation (Gamliel and Gabay, 2014). Two studies also assessed a sense of comfort with cross-age groups, demonstrating a significant increase after 4 weeks of engagement (Belgrave and Keown, 2018), and a time x group interaction effect for baseline vs 6 weeks, in which comfort increased in the intervention group (Sun et al., 2019).

The qualitative component from Chapman and Neal's study (1990) provided supplementary evidence on positive attitudinal changes amongst older adults, who reported increased trust of the teenagers and reinforced pre-existing positive feelings about them. Generally positive perceptions of the younger generation at the outset were also personally validated and substantiated after participating in the programme in two other studies (Barnard, 2014; Belgrave and Keown, 2018). Notably, one of the qualitative studies revealed a substantial positive shift in the older adults' perceptions of young people, from generally negative views at the beginning of the programme to a positive image of the youths as helpful and relatable (Santini et al., 2018). Additionally, Johnson (2014) provided qualitative evidence of improved reactions about growing older and perceived disadvantages of older age.

Four studies included individual outcomes such as: expectations of ageism (Halpin et al., 2017); older adults' stereotyped perceptions of themselves (Hernandez and Gonzalez, 2008); attitudes towards ageing (Lin et al., 2017); and cross-age stereotypes (qualitative findings; Alcock et al., 2011). One of the studies showed positive changes such as a reduction of age-group stereotypes (Alcock et al., 2011). No significant effects of IE were found for expectations of ageism (Halpin et al., 2017), opinions about themselves (no inferential analyses conducted; Hernandez and Gonzalez, 2008), or attitudes towards ageing (Lin et al., 2017).

3.9.3. Social interactions/activity

Eleven quantitative studies (three RCTs, four non-randomised controlled trials, two mixed-method studies, two pre- and post-test study) and two qualitative studies assessed social interaction outcomes. Three controlled trials showed positive intervention effects on: neighbours' helpfulness and people's honesty (de Souza and Grundy, 2007); family relationships (de Souza and Grundy, 2007; Fujiwara et al., 2009); social activity (e.g. attending church/religious service, playing cards/games, going to plays/concerts; Parisi et al., 2015); change in number of people one could turn to for help (Fried et al., 2004); and social networks, and receiving and providing social support (group x time interactions, see Table 3; Fujiwara et al., 2009). However, despite the above improvements found in social interactions/activities, two RCTs and one non-randomised controlled trial found differences only on specific measures and one RCT when a specific model of causal effects was used. Positive effects were found in one out of five (Fried et al., 2004), three out of nine (de Souza and Grundy, 2007), and six out of sixteen (Fujiwara et al., 2009) subscales. A significant effect was found in social activity at the 12-month follow-up, but only when Complier Average Causal Effect (CACE) Modelling was used, which takes adherence into account, and the effect was not found at 24 months (Parisi et al., 2015). Furthermore, two non-randomised controlled trials found no reliable change in social functioning (e.g. visiting friends at their homes, giving advice to family or a friend, Sakurai et al., 2016) and in older adults' sociability (Xu et al., 2016).

One of the pre- and post-test studies reported a significant decrease on a general score of social isolation (Lee and Kim, 2019). However, one of the components of the measure, perceived (lack of) social support, despite an observable decrease, did not reliably change over time. Interpersonal behaviour as one of the aspects of the IE was assessed in one of the non-randomised controlled trials (Sun et al., 2019). Older adult participants showed significant positive changes in three out of six behaviours, including visual attention to younger participants, initiating conversation, and frequency of physical contact with young group members. One study additionally considered an individual outcome of intergenerational solidarity, which was not reliably affected by IE (Chung and Kim, 2020).

Qualitative evidence from two programmes indicated a positive effect on sense of community (Alcock et al., 2011) and community involvement (Barbosa et al., 2020). However, the interpretation of results in Barbosa et al. (2020) was not substantiated by the included data. Three other studies revealed the potential of IE to build intergenerational relationships through shared activities, an exchange of social experiences, and time spent together, and even encouraged expansion of social interactions outside of the programme (Kamei et al., 2011; Santini et al., 2018). Moreover, the knowledge and skills learned from the younger generation can serve as a means for older adults to connect with family, friends, and wider social networks, as well as enhancing their sense of independent living and providing practical support in everyday life (Lee and Kim, 2019).

3.9.4. Social outcomes – summary

In summary, the measures presented in this section covered a wide

range of social outcomes and varied across studies more than in any other outcome category. However, the most common social outcomes investigated across diverse IE programmes were cross-age attitudes and generativity, and those two outcomes were fairly consistently enhanced by IE (e.g., Ehlman et al., 2014; Gruenewald et al., 2016; Meshel and McGlynn, 2004; Pinquart et al., 2000). Social interaction exhibited more mixed findings, with benefits typically being observed only for a minority of subscales assessed.

4. Discussion

This systematic review comprises a comprehensive evaluation of existing evidence regarding the effectiveness of intergenerational engagement (IE) for benefiting older adults' cognitive, social, and health–related outcomes. Based on the engagement hypothesis (Stine-Morrow et al., 2007), the scaffolding theory of ageing and cognition (Reuter-Lorenz and Park, 2014), and Erikson's model of late life need for generative engagement (Erikson et al., 1986), IE programmes could be expected to benefit older adults' social and health-related outcomes, as well as to induce compensatory neural effects, resulting in cognitive behavioural benefits. Both qualitative and quantitative evidence was synthesised, revealing some positive findings. However, heterogeneity of IE (e.g. context, dosage, and duration) and study designs and methods, including selected outcome measures, was also identified. The available quantitative research demonstrated several consistent, positive changes related to cognitive, health and wellbeing, and social outcomes, while qualitative studies supplemented the findings primarily on the health and social benefits of IE from the perspective of programme participants.

4.1. Cognitive outcomes

Older adults derived some cognitive benefits from IE. Studies generally provide support for the short-term, but not long-term, impacts of IE on some components of cognition, although long-term exposure requires much more investigation. In particular, two of the three studies on executive function observed short-term benefits across behavioural measures of executive function (Carlson et al., 2008). These positive results therefore provide initial support for the theoretical model of cognitive and brain ageing proposed by Reuter-Lorenz and Park (2014) and for the potential health benefits of late-life generativity. IE may engage older adults in a more enriched environment that promotes neural scaffolding and reduces the cognitive declines associated with ageing. Specifically, long-term exposure to cognitively, physically, and socially demanding IE might stimulate brain plasticity and create new neural pathways that facilitate improved cognition (Hertzog et al., 2008; Lövdén et al., 2010). Notably, duration-dependent increases in intellectual lifestyle activities have also been observed post-intervention (Parisi et al., 2015).

Structural and functional brain outcomes fell outside the scope of the present review, but there is evidence that these may also be positively associated with IE, potentially explaining the positive behavioural effects observed. For example, Carlson et al. (2009, 2015) reported positive IE-related neural changes in areas underlying memory and executive functioning (i.e. increased brain activity in left prefrontal and anterior cingulate cortex, and halted or reversed declines in hippocampal volume in male participants). Additionally, while Sakurai et al. (2018) observed no significant behavioural effects, hippocampal volume declined in their control group but was maintained in their intervention group. Additional high-quality studies are therefore clearly warranted in order to specify the range of influences of IE on cognitive performance as well as the underlying brain structure and functioning over time, bearing in mind that there may be neuronal changes that are not mirrored in cognitive testing, particularly over shorter study durations.

4.2. Health and wellbeing outcomes

Some significant, positive effects of IE were demonstrated on health and wellbeing. The most consistent improvements were observed in relation to anxiety (Halpin et al., 2017; Sng and Jung, 2020; Xu et al., 2016). All three studies that assessed this outcome reported a significant reduction in anxiety, including its social and emotional dimensions. However, effects of IE on other health and wellbeing outcomes varied across studies and only a few reported reliable positive changes in depression (e.g., Hernandez and Gonzalez, 2008; Kamei et al., 2011), loneliness (Gaggioli et al., 2014; Lee and Kim, 2019), life satisfaction (DeMichelis et al., 2015; Meshel and McGlynn, 2004), and self-rated health and wellbeing (e.g. Fujiwara et al., 2009; Hsu et al., 2014).

Qualitative data from two other studies supplemented these findings, revealing positive effects of IE on wellbeing by providing cognitive stimulation and improving participants' mood (Chippendale and Boltz, 2015; Santini et al., 2018). IE constituted for participants a distraction from negative thoughts and health-related concerns (Santini et al., 2018) and offered a safe social space where concerns and emotions could be shared (Chippendale and Boltz, 2015). These, along with the quantitative findings, provide support for the benefits of volunteerism that is incorporated in IE. Voluntary altruistic activities that are a part of social engagement may serve as a means to maintain older adults' quality of life and increase their levels of life satisfaction (Cipriani, 2007). They also promote their sense of purpose that, in turn, can contribute to improved wellbeing (Chippendale, 2013). Other benefits of volunteering can include better self-rated health (Morrow-Howell et al., 2003) and reduced depression and anxiety (Thoits and Hewitt, 2001). However, these benefits in wellbeing outcomes may depend on the individuals' and programme characteristics (Morrow-Howell et al., 2009), which could explain the variations in evidence demonstrated in this review.

Relatively consistent benefits of IE were demonstrated in relation to physical health (Fried et al., 2004; Perry and Weatherby, 2011 Strand et al., 2014; Tan et al., 2006, 2009). Three out of four studies reported significant positive effects on overall physical activity levels (Fried et al., 2004; Strand et al., 2014; Tan et al., 2006, 2009). Significant positive intervention effects were also demonstrated on other aspects of physical functioning, including hand grip strength (Fujiwara et al., 2009; Sakurai et al., 2016); self-reported strength, and proportion of participants reporting feeling stronger (Fried et al., 2004); functional reach (Sakurai et al., 2016); and walking speed (Fried et al., 2004). However, significant increases in physical activity and functioning were often reported among people who were physically inactive at baseline (e.g., Fried et al., 2004; Tan et al., 2006, 2009). Also, the specific physical functioning measures that showed benefits were inconsistent and/or dependent on follow-up period. Therefore, more evidence is needed to be able to draw firmer conclusions on the influences of IE on physical activity and functioning as well as their interrelation with other health and wellbeing outcomes.

Despite observed positive changes across various measures of mental health, quality of life, self-rated health and wellbeing, physical activity, and physical functioning, 10 of 31 quantitative studies reported no significant effects (e.g., Adam, 1992; Carstensen et al., 1982; Johnson, 2014; Young and Janke, 2013), and those that did were often on specific measures or sub-scales (e.g., Gaggioli et al., 2014; Kamei et al., 2011; Mahoney et al., 2020). Therefore, future studies should aim to include standardised, outcome-specific measures that have strong underpinnings in theoretical and empirical evidence and that are justified by their hypotheses. More evidence is also required on the individual subscales that showed any changes.

4.3. Social outcomes

One of the most common social outcomes investigated across diverse intergenerational programmes was cross-age attitudes and perceptions. Four out of seven quantitative studies that statistically analysed the impacts of IE on cross-age attitudes, revealed their positive impact on older adults' perceptions of young people's skills and their personal

qualities (e.g., teaching skills, trustworthiness; Gamliel and Gabay, 2014; Meshel and McGlynn, 2004). Generally positive perceptions of the younger generation reported at the outset of the IE seemed to be validated and substantiated through participating in the programme (Barnard, 2014; Belgrave and Keown, 2018; Chapman and Neal, 1990; Chippendale and Boltz, 2015). Initially negative views were also improved substantially over the course of IE (Santini et al., 2018). This can enable connectedness, improved the level of cross-age comfort (Belgrave and Keown, 2018; Sun et al., 2019), and reduced distance between the generations that consequently reduced age-group stereotypes and anxiety over ageism (Alcock et al., 2011; Halpin et al., 2017).

Increased intergenerational connectedness could be also translated into a feeling of affinity with the wider community. Social networks involving the younger generation, established via the programmes, increased frequency of contact with their grandchildren and with children outside their neighbourhood (Fujiwara et al., 2009). IE could also enhance communication skills that, in turn, may enable interchange with members of other generations and social networks. The new supportive relationships built within IE were found to be a motivator to provide social support to friends and neighbours (Fujiwara et al., 2009). They also facilitated participants' perceptions of people's honesty and neighbours' helpfulness (de Souza and Grundy, 2007), and resulted in a significant increase in the number of people they can ask for help (Fried et al., 2004).

However, in this review we also found potential intervention effects in terms of shifts in social support. For example, a decrease in the number of people providing emotional support (Fried et al., 2004) or in received support was reported (Fujiwara et al., 2009). The findings might indicate that participants perceived themselves as needing less support, as a result of getting more active via participation in the programme. However, the authors suggested that a decrease in the outcome could be associated with participants' personal commitments (e.g., care for family members) and culture-based values rather than with participating in IE (Fujiwara et al., 2009). A sense of pride and inhibited ability to accept help were provided as possible explanations for the effect on receiving social support (Fujiwara et al., 2009). Therefore, implications of social, cultural, and political mechanisms need to be taken into consideration when developing and evaluating the effects of IE.

An outcome that seemed to be consistently enhanced by IE was generativity (Ehlman et al., 2014; Gruenewald et al., 2016; Sanders et al., 2013). All studies that evaluated this variable, whether quantitative or qualitative, demonstrated consistent positive effects of IE on perceptions of generativity. Although the perception of being generative is generally associated with later life, those studies showed that it could be further increased by engagement in actual generative behaviour (Cheng, 2009). Active IE restored older adults' sense of purpose and self-worth resulting from the opportunity to share their knowledge and experiences with the younger generations and positively contributing to their growth (Barnard, 2014; Chippendale and Boltz, 2015; Mahoney et al., 2020; Wilson et al., 2013). The new role as mentor or educator gave them an opportunity to inspire the students and validate their own skills and potential.

Given the potential implications of positive self-perceptions of generativity on mental health, cognitive and physical functioning, and longevity (Grossman and Gruenewald, 2020; Gruenewald et al., 2009), an examination of these interconnections should be an objective of future research. In the current review, generative desire was a common feature among different intergenerational programmes and an important factor contributing to improvements in participants' psychological wellbeing (e.g., Ehlman et al., 2014; Sanders et al., 2013). This conclusion is consistent with Erikson's (1950) hypothesis that older adults need to be generative for their health and wellbeing and was supported in several studies on the relationship between generativity or a sense of meaningfulness and health outcomes (e.g., Hofer et al., 2014; Landes et al., 2014; Murayama et al., 2015). However, generative activities may only bring health benefits when those actions are valued and respected by others (Cheng, 2009).

4.4. Strengths and limitations of this systematic review

Regarding limitations of this systematic review, by necessity our searches were restricted to records that were published in the English language. Therefore, we might have produced language bias since, according to the CRD (Egger et al., 1997), studies from non-English-speaking countries are less likely to be published in English if they report non-significant results. We also included only published studies and theses (available online), and therefore there is the possibility of publication bias affecting our results. However, 25 of the assessed programmes reported non-significant changes in outcomes under consideration, which may to some extent limit any overestimation of intervention effects.

Despite these limitations, this review provided a comprehensive synthesis of a variety of IE programmes. Our searches were not restricted to the date of publication, as compared to other reviews (Canedo-García et al., 2017; Ronzi et al., 2018), which allowed us to identify additional records and extend our analysis on the effectiveness of IE on a range of outcomes. The scope of this review was also not restricted by the type of research methodology used, research setting, study duration, or number of participants involved. Our review appraised a diverse range of intergenerational interactions and summarised evidence from qualitative, quantitative, and mixed-methods studies. We were therefore able to gain more insight into the complexity of the constructs under investigation.

Studies reviewed here indicate that valuing and exercising life experience through IE may lead to health benefits in cognition, wellbeing, and health. We can now infer that these systems remain plastic throughout life and remain ready to incorporate new experiences (Reuter-Lorenz and Park, 2014). As we approach a time when the number of older adults equals the number of children, IE programmes may offer health benefits that outweigh reductionist approaches focusing solely on cognitive or physical exercise.

4.5. Implications for policy and practice

This review revealed both short- and long-term IE programmes that demonstrated the potential to improve health outcomes and/or contribute to meaningful social benefits for older adults (e.g., Carlson et al., 2008, 2009; Fujiwara et al., 2009; Gamliel and Gabay, 2014; Hsu et al., 2014). These studies were implemented in different contexts and involved different activities, but all were community-based for participants' convenience and to tackle particular social issues (e.g., health and wellbeing in older adults, disengagement after retirement, negative cross-age attitudes). Although not all programmes may be translatable to all cultures and societies, the existing types of IE offer a wide range of options that can be adapted to different social needs and existing community approaches.

For example, studies that involved knowledge exchange between two generations and were based in the community or in centres for older people (e.g., Hsu et al., 2014; Johnson, 2014) are transferable for implementation in any countries and specific communities that have well-established venues where generations can meet. The purpose of IE meetings may also depend on the availability of resources and/or specificity of local groups. For example, access to computers may facilitate technological knowledge and skills in older adults and teaching skills in the younger generation (Gamliel and Gabay, 2014; Johnson, 2014). Conversely, some community groups that target particular challenges of the older adult population (e.g., transition to retirement) and are involved in hands-on activities (e.g., woodworking, gardening), may be suited for selected groups of participants (Mahoney et al., 2020; Wilson et al., 2013).

School-based programmes such as Experience Corps (EC) in the United States or Research of Productivity by Intergenerational Sympathy (REPRINTS) in Japan demonstrate that long-term, effective intergenerational initiatives do not have to be high-cost and can result in

positive outcomes for both the older adults and their communities (e.g. Fried et al., 2004; Murayama et al., 2015). This indicates that implementing even long-term intergenerational interventions that are purely voluntary is feasible. The REPRINTS programme did not provide the participants with any incentives, yet they were able to retain volunteers for up to 7 years (e.g., Sakurai et al., 2016). Moreover, although EC provided their participants with stipends to cover the costs related to participation, volunteers tended to commit more hours than they were reimbursed for (Fried et al., 2004). From a policy perspective, then, regular intergenerational initiatives like those described in this review, constitute an effective strategy to build age-friendly communities and potentially produce health and wellbeing benefits for older people. Our analysis also suggests that the impact of IE may differ depending on participants' baseline functional levels (Carlson et al., 2008; Kamei et al., 2011; Tan et al., 2006). Thus, future initiatives should ensure to consider potential baseline factors that may moderate the outcomes.

4.6. Future research

Although there is increasing public interest and need to promote physical, cognitive, emotional, and social functioning in older adults through programmes such as IE, there is a lack of comparable and widely applicable models for their implementation. The diversity of designs and assessments used thus far within IE research limits the ability to draw strong, generalised conclusions. In order to attain greater consensus about the effectiveness of IE, standardised instruments should be utilised to a greater extent to enhance data quality and comparability across studies. They should be, if possible, specifically designed (e.g., The Life Satisfaction Index for the Third Age-Short Version; Barrett and Murk, 2009) or validated (e.g., International Physical Activity Questionnaire Short Form; (Craig et al., 2003)) for older adults, to ensure they are appropriate for use and sensitive to potential effects of interventions. In addition, the research community may also consider multi-site/institution collaborative studies with agreed unified protocols so that larger datasets may be pooled and merged for analyses. Furthermore, the reviewed literature revealed a small number of RCTs used to examine impacts of IE. Randomly assigning participants to groups in controlled studies will facilitate higher quality demonstrations of potential intervention effects and, where possible, blinding the outcome assessors to the participants' groups can reduce detection bias. These will not always be possible, however, particularly in 'real-world' studies involving long-term participation. When this is the case, the lack of randomisation must always be borne in mind when interpreting results. The EC (e.g. Fried et al., 2004) and REPRINTS (e.g. Fujiwara et al., 2009) programmes, given their long-term and successful implementation, could constitute a possible solution in terms of effective programme designs and their application. Overall, however, it is important to highlight that efforts to ensure scientific rigour in both qualitative and quantitative research in this challenging form of 'real-world' research, which often takes place over extended periods of time, should be assessed with this context in mind. Efforts should be acknowledged as far as possible, for example when assessing study quality.

Differences in socio-political context of retirement and cultural norms regarding older adults' roles should be considered when designing and implementing IE, however. For example, the socio-political issues of Brazilian society, including inequalities and age-discriminations could influence some of the participants' views of social interactions. As a result, their willingness to participate or adhere to the programme could be affected (de Souza and Grundy, 2007). EC, set in the United States, emphasised the importance of financial support for the programme volunteers to allow them cost-free participation (Fried et al., 2004). The EC stipends were also found to promote wider inclusion and increase retention in the programme (McBride et al., 2011). Additionally, methods applied may also be context-dependant. REPRINTS, as a high-quality, long-term intervention that aspired to implement all 'gold-standard' intervention procedures, was not able to randomise the sample as a result of "political realities in the local municipality" (Sakurai et al., 2016; p. 14).

Programmes may also usefully build upon existing 'grassroots' movements in the particular cultural context. For example, Men's Sheds was established for men to address the challenges associated with the transition to retirement (Mahoney et al., 2020; Wilson et al., 2013). Men's Sheds allowed both the young and older generations to bond through 'hands-on', traditionally masculine activities. Understanding the conception of masculinity in Australia that indicates a causal relationship between engaging in masculine activities and social support, sense of achievement, or sense of identity (Drummond, 1995), was crucial to developing positive intergenerational interactions, beneficial for all involved.

Thus, future research studies should implement controlled randomisation wherever possible, and should draw upon design features and outcome measures from previous successful studies, while considering the cultural and socio-political context. If these three conditions are adhered to, future interventions may have the potential to provide more robust, scientifically rigorous and translatable evidence of the causal attribution of effects. All these will help identify roles and activities for older adults that are most effective in enhancing their health and wellbeing. Furthermore, studies included in this review primarily reported on psychosocial and health and wellbeing effects of IE and relatively few investigated impacts on cognition. Thus, more large-scale interventions are recommended to allow stronger conclusions to be drawn about the potential benefits of IE, particularly regarding older adults' cognitive functioning.

There is a lack of studies examining the potential effects of IE dosage. Only two studies included in this review demonstrated a dose-response relationship, suggesting a more positive intervention effect on generativity as a function of the greater level of exposure to the programme (Gruenewald et al., 2016; Parisi et al., 2015). This evidence suggests that high-intensity engagement for an extended period of time may be particularly beneficial for older adult participants. However, little is known about the impact of intervention exposure on other aspects of older adults' functioning. Therefore, future research should explore the impact of dosage and duration of engagement, and where the threshold for improvement lies. In addition, the nature or more precise modality of the IE programme (e.g., knowledge exchange, exergaming, crafting sessions) could be considered as a potential predictor of effectiveness, particularly as more evidence accrues over time. Hence, future interventions could usefully investigate the outcomes of various modes of IE, while also carefully controlling for the fidelity of implementation.

It is also crucial to understand the long-term effects of IE following the intervention. All the included research records examined changes from pre- to post-intervention test, but only one programme conducted a further follow-up with participants, eight weeks after the completion of IE (Newman et al., 1995). An increase in longitudinal interventions with further follow-ups after months or years post-programme would strengthen the evidence related to IE, indicating whether any changes endure at a later timepoint. Furthermore, mixed-methods designs should be considered as a more standard approach in IE research, including comprehensive evidence on the perceived impacts and experiences of participating in IE programmes, from various perspectives. In addition, multiple comparison conditions should be used to a greater extent in future, to help determine the specific effects of IE. For example, a non-engagement group as well as a social engagement only (non-IE) group would help to control for the potential effects of increased social interaction vs IE specifically. Finally, we suggest that greater adoption of 'open science' practices (e.g. using Open Science Framework; https://osf.io/) and promoting data-sharing (i.e. making datasets openly available) would further enhance this research area. More study pre-registrations and openly available preprint publications could also help to minimise selective reporting of results and increase publication of both significant and null results.

4.7. Conclusions

This review identified a wide range of potential benefits of IE for older adults. The heterogeneity of the form of IE and the chosen outcome measures could indicate many possibilities for future practice, but it might also account for the many discrepancies in findings. Those differences may also indicate that more explanatory research is required to reveal when, where, and how the benefits might be derived. Nonetheless, some relatively consistent, positive effects were found on several outcomes, including anxiety, generativity, cross-age attitudes, and physical activity. The impacts of intergenerational programmes on specific cognitive outcomes were not reliable across multiple studies, and need to be addressed more in future, ideally in large-scale interventions. Overall, this review suggests that, to better establish the cognitive, health, and social outcomes of IE, more research is required that involves: 1) both quantitative and qualitative measures; 2) 'gold standard' and comparable models, allowing wider implementation and generalisability of findings; and 3) RCTs, wherever possible, to generate the highest quality evidence.

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Declaration of Competing Interest

MC serves on the Scientific Advisory Board of the AARP Staying Sharp programme. There are no other interests to declare.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.arr.2021.101400.

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