Systematic Review

The Longitudinal Evidence on Social Ties and Fruit and Vegetable Intake among Aging Adults: A Systematic Review

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Context: *Social ties are associated with the mortality and morbidity of aging populations; however, the role of social ties in healthy eating practices or gender differences in this link is less understood.* ***Objective:*** *The objective of this study was to examine the longitudinal evidence for the impact of changes in social ties on fruit and vegetable (FV) intakes among aging adults, with attention to gender differences.* ***Data Sources:*** *Medline, Embase, Scopus, CINAHL, and ProQuest databases were searched until December 2022.* ***Data Extraction:*** *Longitudinal studies evaluating changes in living arrangement, marital status, social network, or social participation and changes in FV intake among middle- and older-age adults were included. Data from the included studies were extracted using a standardized template and analyzed using a narrative approach.* ***Data Analysis:*** *A total of 4956 titles were eligible after deduplication, and 75 full texts were screened. Seven studies met the inclusion criteria, and all examined marital transitions only. Five marital transitions were assessed: staying married, becoming widowed, becoming divorced, remaining unmarried, and becoming married. Both the quantity and variety of fruit and/or vegetables eaten were studied. Three of the included studies had only male or only female populations. The studies found that marital dissolution (divorce or widowhood), and remaining unmarried, were associated with reduced FV intakes in older women or men, compared with staying married. The associations were stronger in men than in women. Two studies showed that becoming married was associated with increased vegetable intakes, but 3 reported null results. The included studies were of medium quality.* ***Conclusions:*** *There is a paucity of longitudinal research on whether changes in social ties are associated with changes in FV intakes among aging adults. This review showed that specific marital transitions may influence healthy eating habits, especially in older men. No evidence exists on whether changes in other social ties might alter healthy eating.*
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INTRODUCTION

The aging population is increasing worldwide,[1] and the proportion of individuals aged 65 and above will reach 1 in every 6 people by the year 2050.[2] The global nature of this demographic shift makes it imperative to place greater focus on promoting healthy aging across life transitions. Healthy aging has a broad goal that goes beyond simply extending a person's lifespan—it aims to prolong the duration of active and healthy living. As individuals reach middle and older age, chronic diseases tend to become more prevalent.[3] Good nutrition and healthy eating habits are critical for healthy aging, especially among older adults.[4]

In particular, the consumption of fruits and vegetables (FV) is an established indicator for healthy eating and a good quality diet,[5] and is a universal dietary recommendation for primary and secondary disease prevention.[6] Multiple studies show that higher FV consumption lowers the risk of cardiovascular diseases,[7–9] type 2 diabetes,[10,11] cancer,[12] and overall mortality.[13,14] Additionally, higher intakes of vegetables are linked to slower cognitive decline in older adults[15,16] and less depression.[17] However, eating patterns and nutrient intakes are known to change as people enter mid to later life due to various physiological, psychological, and social changes.[18–20] Older adults specifically face barriers to adequate intake of FV due to factors such as changes in appetite, compromised oral health, mobility limitations, and physical health decline.[21] Moreover, socioeconomic factors are also associated with FV consumption among the aging population, with research indicating that older adults with lower educational attainment and household income levels are at greater risk of not meeting daily recommended FV intake.[22]

The social context is especially important as a determinant of food choices and has been shown to influence appetites and eating habits in aging populations. In particular, aging in mid-to-late adulthood coincides with major transitions in social ties, often resulting in a high degree of social isolation.[23] Marriage, in particular, is a social factor with a strong association with adults' food choices, and married older adults are known to consume more FV than older adults who are not married.[24] By corollary, widowed older adults tend to have poorer nutrition compared with those who have not experienced the loss of a spouse.[25] Other work shows that living arrangements and social contacts are also associated with FV intakes of older individuals.[26–28] Specifically, living alone,[29] lower social participation,[30] lower social support,[31] and being socially isolated,[32] are all associated with greater nutritional risk and poorer dietary intake, including lower FV intake, in older adults.

Sex and gender differences in the role of social ties in healthy eating among aging adults are also important to consider.[26] Different types of social ties can either increase or decrease FV intake in unique gendered ways, due to the socially constructed differences between females as women and males as men in terms of the quantity and scope of their social interactions,[33] as well as the differential health impacts of specific social ties.[34,35] For example, widowed men in Britain had lower FV consumption, but widowed women had higher vegetable intake.[26] Thus, understanding which social structures are associated with changes in FV intakes over time, using a gender lens, is critical for informing healthy aging strategies, and for improving environmental approaches to nutrition interventions for subpopulations of aging adults. This systematic review therefore aimed to determine "what is the impact of social tie transitions on changes in FV intake among aging adults, and is there a difference by gender?"

METHODS

Search and data sources

The peer-reviewed literature was systematically searched using 5 bibliometric databases, including OVID/Medline, OVID/Embase, Scopus, CINAHL, and ProQuest Dissertations and Theses, until December 2022. Additionally, any potentially missed publications were retrieved through citation chaining forward and backward by reviewing the reference lists of any review articles and all included full-text articles. Various free-text thesaurus and MeSH terms were used to capture the PICOS concepts of the research question (Table 1), including population (middle-aged and older; aging adults; adults in retirement transition); social tie exposures based on established classification of structural social ties[36] (ie, changes in marital status, living arrangement, social network size, or social participation); and healthy eating outcome (defined as change in FV intake). The terms used in the databases are summarized in Table S1. The language of included articles was restricted to English, French, Spanish, or Persian, with no date restriction. The first author (S.M.) performed the searches in consultation with a medical information specialist and the senior author (A. I.C.) and developed database-specific syntaxes (see Table S2). This study is registered with PROSPERO (CRD42022365795) and has followed PRISMA guidelines for systematic reviews.[37]

Table 1. PICOS Criteria for Inclusion of Studies

PICOS	Criteria
Population	Middle- and/or older-aged adults (45 years and over); aging adults; adults at the transition of retirement
Intervention/ Exposure(s)	Changes in structural social ties (ie, marital status, living arrangement, social network, or social participation)
Comparator(s)	Stable social ties
Outcome(s)	Changes in fruit and/or vegetable intake
Study design	Longitudinal, cohort, case-control, RCT

Screening

The search results were imported to an EndNote library, and after removing duplicate articles were exported to Covidence Systematic Review Software for screening. The first reviewer (S.M.) and the second reviewers (A.I.C., R.M., and R.P.) independently screened the titles and abstracts for eligibility. Relevant full texts were retrieved, including contacting the corresponding author, and read in full for final eligibility. Any disagreement between the independent reviewers was discussed with, and a final decision was made by, the senior author (A.I.C.).

Inclusion and exclusion criteria

A study was eligible for inclusion if it reported original research showing the longitudinal association between change(s) in a social tie (eg, marital transitions, increase or decrease in social network size, etc.) with change(s) in fruit and/or vegetable intake among middle-aged (45–64 y) and older-aged (65 and over) adults. Studies with either the exposure or outcome measured at one time point were excluded, as were studies with a wide range of age (eg, 18 years to 65 years)—unless the results were stratified for middle-age/older groups. In terms of trials, those studies that did not clearly focus on changes in social ties as their intervention (eg, a dietary program with social support) were also excluded. Studies with cross-sectional or qualitative design, and studies on clinical populations, were not eligible.

Data extraction and study quality assessment

Data from the included studies were extracted using a standardized evidence table (with Excel) with predetermined headings. Key information collected included: stated study objective, design, year, population, geographical setting, exposure description, outcome(s) measured, covariables, reported findings, author, and source. Gender- and age-specific findings were included in the results field as appropriate, and any missing data were obtained by contacting the corresponding author. The quality of the included studies was assessed using an adapted checklist of itemized criteria for population-based evidence[38] consisting of 28 questions and 3 response categories ("yes," "no," and "cannot tell"). The criteria covered research question, design, representativeness, sampling, comparability, compatibility, completeness, results, conclusions, and generalizability. A study was deemed of high quality if $\geq$80% of the checklist questions received a "yes" response, while a study was considered of low quality if $<$20% of the questions received a "yes" response. The quality assessments were conducted by the first author (S.M.).

Data analysis

The reported findings based on any summary measures of prospective associations (eg, odds ratios, β, and mean difference) were synthesized through a narrative approach. All reported SDs or SEs were converted into a 95% CI for consistent reporting of review findings.

RESULTS

Our search resulted in 4956 potential studies after duplicates were removed, and 75 eligible full texts, of which 7 studies met the inclusion criteria for data extraction and quality review (Figure 1). These reported on work undertaken between the early 2000s and 2021, mainly from the United States ($N=3$),[39–41] but also from the United Kingdom ($N=1$),[42] France ($N=1$),[43] Japan ($N=1$),[44] and Australia ($N=1$).[45] Most studies were found through the OVID/Medline and Scopus databases, but 2 additional records were identified through hand-searching.

Study quality

All of the included studies were of medium quality. Limited comparability (eg, control for bias, and subgroup analysis),[39–45] incompleteness (eg, capturing all potential effects within the study period),[39–45] and lack of generalizability (eg, applying results to other settings)[39–41,43–45] were the main quality limitations of the included studies. The assessment of study quality is presented in Table S3.

Study design and sample characteristics

All included studies used longitudinal designs and middle-aged or older populations (Table 2)[39–45]; 3 studies used occupation-based cohorts (ie, male health professionals, female nurses, French workers).[39,40,43] The

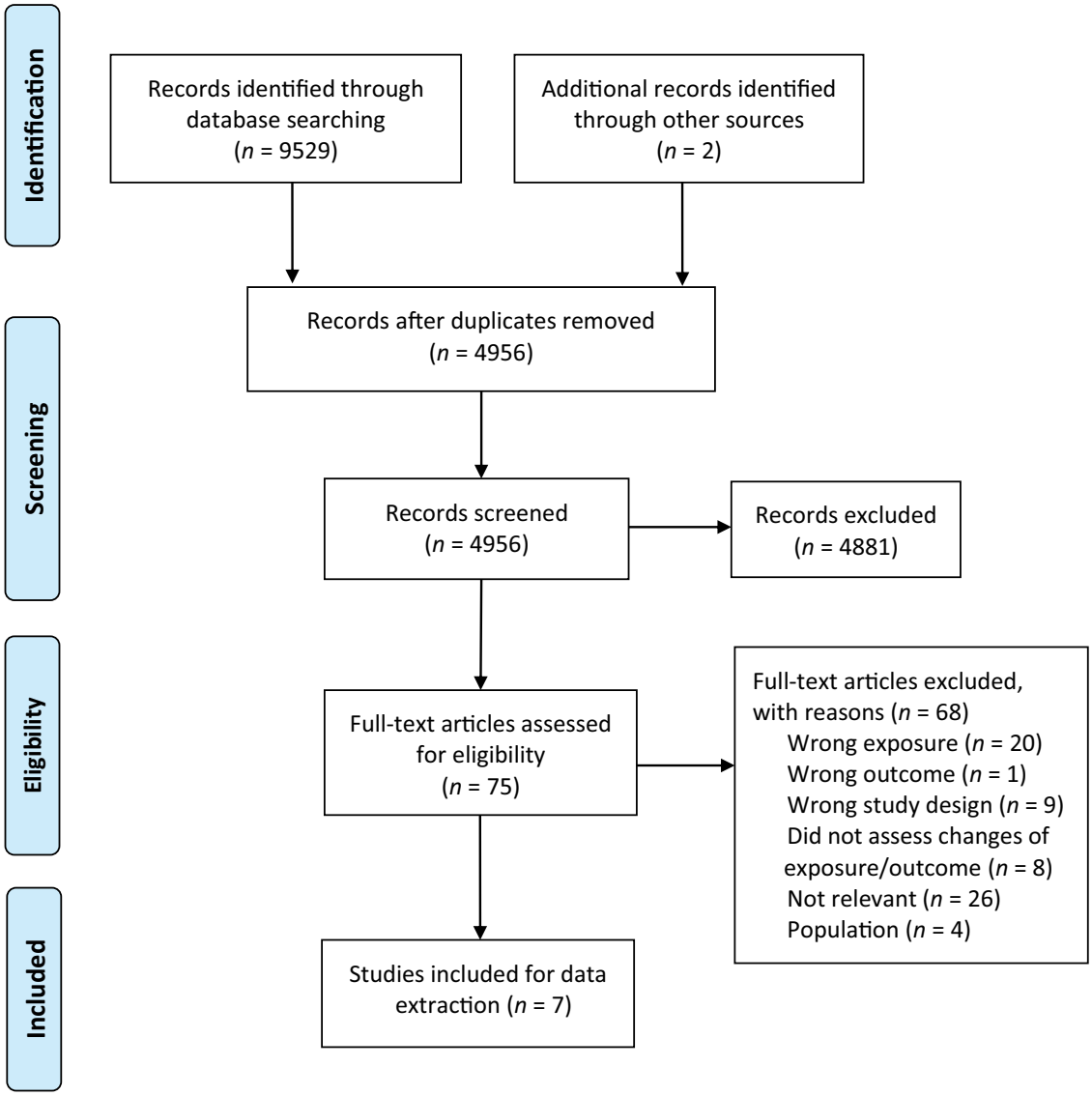

Figure 1. PRISMA Flow Chart of the Process of Study Selection

follow-up periods in the studies varied widely, spanning from 3 years to 25 years, yet the predominant duration was ~4 years. The sample sizes in the studies also varied, ranging from 4813 to 68 705 participants. Most studies included both women and men[42–45] and also specifically stratified analyses (using "sex").[42–44] However, 2 focused exclusively on women[40,41] and 1 focused solely on men.[39] Finally, all studies collected self-reported dietary data using validated Food Frequency Questionnaires (FFQs)[39–45] to assess fruit and/or vegetable intake.

Exposure definition

All the studies defined social tie transitions based solely on marital status, with all studies assessing marital dissolution (ie, becoming widowed and/or divorced). Four studies classified marital transitions into 5 distinct categories (those who stayed married, became widowed, became divorced, remained unmarried, or became married),[39,40,42,44] with 2 studies excluding single participants from the unmarried category.[39,40] Two studies exclusively included married participants at baseline to compare 2 groups (those who remained partnered and those who became nonpartnered),[43] or 3 groups (those who remained married, became divorced, or became widowed).[45] These 2 studies did not assess the transition of individuals who became married or remained unmarried. One study focused on marriage and widowed transitions among women only, which were assessed using 4 groups (those who remained married, became widowed, remained widowed, or became married).[41]

Table 2. Characteristics of the Included Studies

Author/ Source	Stated study objective	Years	Setting	Study design, duration (data)	Study population (*n*)	Description of exposure	Outcome(s) measured	Covariate adjustments
Eng et al (2005)[39] Medline	To examine the effect of change in marital status on health behaviors among men	1986/90 to 1990/94	United States	Longitudinal study, 4-y follow-up (The Health Professionals' Follow-up Study)	Middle-aged and older male health professionals (40–75 y), $N = 38\,865$	(1) Consistently married (reference) (2) Married to widowed (3) Married to divorced/separated (4) Unmarried to married (vs remained unmarried) (5) Remained unmarried	Mean difference in quantity (servings/week) of fruits, fruit juices, vegetables; FFQ	Age, smoking, alcohol intake, body–mass index, physical activity, employment status, history of cardiometabolic diseases, and cancer
Lee et al (2005)[40] Medline	To evaluate the temporal relationship between marital transition and change in health behaviors	1990 to 1998	United States	Prospective cohort, 4-y follow-up (Nurses' Health Study)	Middle-aged and older female nurses (46–71), $N = 68\,705$	(1) Consistently married (reference) (2) Married to widowed (3) Married to divorced/separated (4) Unmarried to married (vs remained unmarried) (5) Remained unmarried	Mean difference in quantity (servings/week) of fruits, fruit juices, vegetables; FFQ	Age, smoking, alcohol intake, body–mass index, physical activity, employment status, history of cardiometabolic diseases, and cancer
Wilcox et al (2003)[41] Hand-searched	To examine whether widowhood is associated with physical and mental health, health behaviors, and health outcomes	1993 to 1998	United States, clinical centers	Prospective design, 3-y follow-up (Women's Health Initiative)	Postmenopausal women (50–79 y), $N = 45\,687$	(1) Consistently married (reference) (2) Married to widowed ($\leq$1 y; $>$1 y) (3) Remained widowed (4) Widowed to married	Beta coefficient of quantity (servings/day) of fruits and vegetables (FV); Health Habits and History Questionnaire; FFQ	Age, education, ethnicity, change in income
Vinther et al (2016)[42] Medline	To examine the relationship between marital transitions and healthy dietary behaviors	1993/7 to 1998/2002	Uniting Kingdome, general practice in Norfolk	Longitudinal study, 3.6-y follow-up (EPIC-Norfolk Cohort)	Middle-aged and older adults (39–78 y), $N = 11\,577$, W (57%)	(1) Consistently married (reference) (2) Married to widowed (3) Married to separated/divorced (4) Unmarried to married (vs remained unmarried) (5) Remained unmarried	Mean difference in quantity (g/d) or variety (items/month) of fruits (11 items) and/or vegetables (26 items); FFQ	Age, change in energy, education, occupation-based social class, and baseline vegetable and fruit quantity or variety

(continued)

Table 2. Continued

Author/ Source	Stated study objective	Years	Setting	Study design, duration (data)	Study population (*n*)	Description of exposure	Outcome(s) measured	Covariate adjustments
Plessz et al (2017)[43] Scopus	To understand how union dissolution affects men's and women's vegetable consumption	1989 to 2014	France, single company	Longitudinal study, 25-y follow-up (Gazel cohort)	Middle-aged and older workers (40–49 y), $N = 14\,019$, W (16%)	(1) Consistently partnered (reference) (2) Partnered to non-partnered	Odds of daily vegetables intake (times/day); annual questionnaire; FFQ	Child(ren)'s departure from the family home, retirement, and house moves
Noguchi et al (2020)[44] Medline	To examine the association between marital transitions and vegetable intake among middle-aged and older Japanese people	2007/11 to 2013/17	Japan, public health center	Longitudinal study, 5-y follow-up (Japan Multi-Institutional Collaborative Cohort Study)	Middle-aged and older adults (40–79 y), $N = 4813$, W (44%)	(1) Consistently married (reference) (2) Married to widowed (3) Married to divorced (4) Unmarried to married (vs remained unmarried) (5) Remained unmarried	Beta coefficient of quantity (g/d) of total vegetables (10 items), light-colored, and green/yellow vegetables; FFQ	Age, sex, BMI, living arrangement, education, employment status, present illness, lifestyle, and energy
Ding et al (2021)[45] Hand-searched	To examine the association between divorce/widowhood and subsequent lifestyles, and psychological and overall health outcomes within short- and longer term duration	2006/09 to 2012/16	Australia	Prospective cohort, short-term (3.35 ± 0.95 y) follow-up; long-term (4.98 ± 0.53 y) follow-up (Sax Institute's 45 and Up Study)	Middle-aged and older adults (45 y and above), $N = 33\,184$, W (53.6%)	(1) Consistently married (reference) (2) Married to widowed (3) Married to divorced/separated	Odds of insufficient FV intake (servings/day) (defined as not consuming the recommended 2 fruits and 5 vegetables a day); SDQ	Baseline FV, age, sex, education, location, country of birth, follow-up time

Abbreviations: W, women; FFQ, Food Frequency Questionnaire; SDQ, Short Dietary Questionnaire.

Outcomes examined

Most studies focused on examining changes in quantity of intake of fruits and/or vegetables, in terms of beta-coefficients of servings per day[41] or grams per day[44]; mean differences of servings per week[39,40] or grams per day[42]; as well as odds of daily intake of vegetables (times per day),[43] or insufficient intakes[45] (defined as below the recommended 2 fruits and 5 vegetables servings/day). Two studies specifically evaluated the change in both the short term and the long term of FV combined.[41,45] Ding and colleagues[45] examined short-term changes (3.35 ± 0.95 years) and long-term changes (4.98 ± 0.53 years) in FV intake, while Wilcox and colleagues[41] categorized participants based on their responses at the 3-year visit to distinguish recent widows (those widowed for a year or less) from longer-term widows (those widowed for more than 1 year). Two other studies solely assessed changes in daily vegetable intake,[43,44] with 1 study focusing on intakes of total vegetable as well as light-colored vegetables, and yellow and green vegetables.[44]

Changes in FV intake variety (total number of unique items per month) were only evaluated by 1 study.[42] Three studies evaluated other dietary changes, such as intake of animal proteins, dairy, breads, cereal, starches, sweets, nuts, non-alcoholic beverages,[39,40] or dietary fat consumption.[41] Changes in other nondietary outcomes were also measured by some of the included studies: lifestyle factors (smoking status, alcohol consumption, physical activity)[39–41,45]; mental and physical health[41,45]; and body weight.[39–41] Measures of change were commonly reported as differences in means,[39,40,42] beta-coefficients,[41,44] or odds ratios.[43,45]

Main findings

The included studies revealed a mixed pattern of longitudinal associations, with studies reporting no change, increases or decreases in FV intake depending on a given change in marital status (Table 3).[39–45]

Marital dissolution and changes in FV intakes. Overall, marital dissolution was associated with significant decreases in vegetable intake, and sometimes also decreases in fruit intake, compared with remaining married.[39–45] In a French study, marital dissolution (becoming unmarried) was linked to lower odds of daily vegetable intake among men (OR 0.62 [95% CI: 0.55, 0.69]) as well as women (OR 0.78 [95% CI: 0.66, 0.90]), compared with individuals who stayed married.[43] However, some dietary effects and their gender differences varied by the type of marital dissolution assessed. Becoming divorced was associated with reductions in vegetable intake in both men and women by, respectively, approximately −2 and −3 servings/week; becoming divorced also decreased fruit intake in men (−0.6 servings/week).[40] One study assessed changes in FV intake variety and found that both men and women showed a reduction in intake of vegetables (−1.6 and −0.74 items/month, respectively) and only men vis-à-vis fruits (−0.64 items/month).[42] Only 1 study reported no association between becoming divorced and change in daily vegetable intake (g/d).[44] Moreover, becoming divorced appeared to be associated with higher odds of insufficient intakes of FV (servings/day) in the long term (∼8 years), but not in the short term (<4 y).[45]

Becoming widowed was consistently associated with decreases in vegetable intake in men across studies and, with 1 exception,[42] also in women. Vegetable quantity decreased among both men[39,42] and women[40] who became widowed: men showed a decrease in the quantity of vegetables in the form of −27.7 g/d,[42] and −2.91 servings/week[39]; and women had a decline of −1.67 servings/week of vegetables.[40] Becoming widowed was also linked to a decrease in the intake variety of vegetables in men by 1.57 items/month, compared with remaining married.[42] Associations for widowhood were also observed among both genders, not only in the form of decreases in total vegetable intake but also decreases in subgroup intake of light-colored vegetables but not yellow-green items.[44] Some studies indicated that widowhood was associated with adverse dietary changes in the short term. Becoming widowed was associated with higher odds of insufficient daily servings of FV intake (OR 1.60 [95%CI: 1.33, 1.92]) for both women and men in the short term (<4 years),[45] and with decreased FV servings per day (β −0.19 [95% CI: −0.31, −0.07]) among recently widowed (≤1 year) women only.[41]

Unlike intake of vegetables, the associations between widowhood and changes in fruit intake were consistently null for men and women,[39,40] or were inverse only in men.[42] Specifically, Vinther and colleagues (2016) showed that older British men who became widowed reported declines in fruit intake quantity by nearly 50 g/d, and fruit intake variety by about 1 item/month.[42] Finally, decreases in FV intake appeared more pronounced for widowed men aged less than 65 years old (−4.22 servings/week) than for widowed men aged at least 65 years old (−1.73 servings/week).[39]

Remaining unmarried and changes in FV intakes. In this review, 5 studies were included that assessed FV intake with remaining unmarried over time as an exposure, and there was a consistent finding in 3 studies that there was no significant association between remaining

Table 3. Summarized Results from the Included Studies

Quality	Authors	Marital dissolution (W/D)	Became divorced	Became widowed	Remained unmarried	Became married	Key reported findings
Medium	Eng et al (2005)[39]	–	M: V ↓ F ↓ FJ[a]	M: V ↓ F[a] FJ[a]	M: V[a] F[a] FJ[a]	M: V ↑ F[a] FJ[a]	Vegetable intake was reduced in men who became divorced (−2.05 servings/week, 95% CI −2.83 to −1.27) or widowed (−2.91 servings/week, 95% CI −3.91 to −1.89), and fruits intake was reduced in those who became divorced (−0.59 servings/week, 95% CI −1.08 to −0.1). Declines in vegetable intakes were stronger among younger than older men. Remarriage was associated with an increase in vegetable intake (1.88 servings/week, 95% CI 0.98 to 2.78).
Medium	Lee et al (2005)[40]	–	W: V ↓ F[a] FJ[a]	W: V ↓ F[a] FJ[a]	W: V ↓ F[a] FJ[a]	W: V ↑ F[a] FJ[a]	Vegetable intake decreased in women who became divorced (−2.93 servings/week, 95% CI −3.87 to −1.99), were widowed (−1.67 servings/week, 95% CI −2.09 to −1.25), or remained unmarried (−0.95 servings/week, 95% CI −1.19 to −0.71) relative to those who stayed married, but increased in those who became married (1.19 servings/week, 95% CI 0.27 to 2.11).
Medium	Wilcox et al (2003)[41]	–	–	W: (ST) FV ↓ (LT) FV[a]	W: (ST) FV[a] (LT) FV[a]	W: (ST) FV[a] (LT) FV[a]	Fruit and vegetable intake decreased in women who had recently become widowed (β=−.188, 95% CI −.31 to −.07) relative to consistently married women.
Medium	Vinther et al (2016)[42]	–	W: F(Q)[a] F(V)[a] V(Q)[a] V(V) ↓ M: F(Q)[a] F(V) ↓ V(Q) ↓ V(V) ↓	W: F(Q)[a] F(V)[a] V(Q)[a] V(V)[a] M: F(Q) ↓ F(V) ↓ V(Q) ↓ V(V) ↓	W: F(Q)[a] F(V)[a] V(Q)[a] V(V) ↓ M: F(Q)[a] F(V) ↓ V(Q) ↓ V(V) ↓	W: F(Q)[a] F(V)[a] V(Q)[a] V(V)[a] M: F(Q)[a] F(V)[a] V(Q)[a] V(V)[a]	Women: vegetable intake variety was reduced in those who became separated/divorced (−0.74 items/month, 95% CI −1.28 to −0.2), and those who remained unmarried (−0.4 items/month, 95% CI −0.6 to −0.3). Men: becoming divorced was associated with a reduction in fruit intake variety (−0.64 items/month, 95% CI −1.16 to −0.12), and vegetable intake variety and quantity (−1.6 items/month, 95% CI −2.35 to −0.88; −35.0 g/, 95% CI −60.8 to −9.2). Variety and quantity of intake of both fruits (−0.62 items/month, 95% CI −1.08 to −0.16; −47.7 g/day, 95% CI −80.6 to −14.9, respectively) and vegetables (−1.57 items/month, 95% CI −2.22 to −0.92; −27.7 g/d, 95% CI −50.5 to −4.9, respectively) showed a reduction in men who became widowed relative to those who stayed married. Moreover, remaining unmarried decreased fruit intake variety (−0.3 items/month, 95% CI −0.5 to −0.1) and both indicators of vegetable intake (−0.6 items/month, 95% CI −0.8 to −0.3; −9.7 g/day, 95% CI −18.9 to −0.5).

(continued)

Table 3. Continued

Quality	Authors	Marital dissolution (W/D)	Became divorced	Became widowed	Remained unmarried	Became married	Key reported findings
Medium	Plessz et al (2017)[43]	W: V ↓ M: V ↓	–	–	–	–	Marital dissolution had a negative association with daily vegetable consumption in both genders, with lower odds of daily intake being sufficient in men (OR = 0.62, 95% CI 0.55 to 0.69) than in women (OR = 0.78 95% CI 0.66 to 0.90) relative to those who remained married.
Medium	Noguchi et al (2020)[44]	–	A: Total V[a] Light-Color[a] Green and Yellow[a]	A: Total V↓ Light-Color ↓ Green and Yellow[a]	A: Total V[a] Light-Color[a] Green and Yellow[a]	A: Total V[a] Light-Color[a] Green and Yellow[a]	Total vegetable intake decreased (β = −16.64, 95% CI −31.69 to −1.59) and light-colored vegetables intake decreased (β = −11.46, 95% CI −19.95 to −2.97) in both men and women who became widowed, compared with those who remained married; men had greater but non-signficiant reductions in vegetable intake.
Medium	Ding et al (2021)[45]	–	A: (ST) FV[a] (LT) FV↓[b]	A: (ST) FV↓[b] (LT) FV[a]	–	–	The odds of insufficient fruit and vegetable intake was higher in those who became divorced over the long term (OR = 1.55, 95% CI 1.12 to 2.15) and in those who became widowed over the short term (OR = 1.60, 95% CI 1.33 to 1.92), relative to those who remained married.

[a]change not significant.
[b] Indicates that the increased odds of insufficient fruit and vegetable intake are a negative aspect. Abbreviations: W/D, marital dissolution of any kind (widowed or divorced); W, women; M, men; A, all (not sex-stratified); ↓, decrease; ↑, increase; –, not assessed; (Q), quantity; (V), variety; V, vegetable; F, fruit; FJ, fruit juice; FV, fruit and vegetable (combination); ST, short term; LT, long term.

unmarried and changes in FV intake, compared with remaining married as the reference.[39,41,44] Only 2 studies reported adverse changes in FV intake being associated with remaining unmarried in women,[40,42] and only 1 included study reported adverse changes in FV intake in men remaining unmarried.[42] Specifically, women who remained unmarried decreased their vegetable intake variety (−0.4 items/month)[42] and vegetable intake quantity (−0.95 servings/week)[40]; men who remained unmarried also decreased vegetable intake variety (−0.6 items/month) and quantity (−9.7 g/d) as well as their fruit intake variety (−0.3 items/month).[42]

Becoming married and changes in FV intakes. Five studies were included that examined the prospective associations between becoming married and changes in FV intake. Three of them reported null associations compared with remaining married as a reference group.[41,42,44] Only 2 sex-specific occupation-based cohort studies found that becoming married was associated with increases in vegetable intake (by just over 1 serving/week in women[40] and by nearly 2 servings/week in men[39]).

DISCUSSION

This systematic review showed that, despite extensive data on social correlates of diet and health in older people, there is a paucity of high-quality longitudinal research to adequately answer the causal question about social ties as determinants of healthy eating among aging adults. There is also limited evidence on whether the impact of social tie transitions on changes in FV intake differs by gender. This review found that current research on the social determinants of healthy eating is largely framed in terms of marital transitions only. Overall, we found 7 medium-quality longitudinal studies on the prospective association between marital transitions and changes in healthy eating in aging adults. However, this literature reported mixed results for changes in FV intake: Fruit or vegetable intake decreased, increased or stayed the same. Studies showed heterogeneity in terms of gender, the time frame over which dietary change was measured, food subtype, and age subgroup. No relevant reviews, or original longitudinal studies of changes in nonmarital social ties and changes in healthy eating were identified.

Overall, the review results showed that marital dissolution was associated with adverse changes in FV intakes among the aging population, which aligns with previous research. Indeed, marital status stands out as the most extensively researched social determinant of health among older individuals, and research has shown that older-age individuals who are married typically display improved appetites, healthier eating habits, and enjoy better overall health and longer life expectancy when compared with their unmarried counterparts.[25,46,47] They also tend to adhere more closely to dietary guidelines.[25,48] Consistently, it has been proposed that married individuals have a significantly higher intake of FV over a 9-year follow-up, compared with those who have been widowed or divorced.[24] Notably, the type of marital dissolution (eg, widowhood or divorce) might be linked to changes in FV intake over different timeframes (eg, short term versus the long term), which deserves further investigation.

Of significance, limited longitudinal evidence indicates that associations between marital dissolution and changes in FV intakes differ between women and men depending on the specific marital transition. This review showed that women who experienced divorce had a more significant decline in their vegetable consumption than the declines seen in women who experienced widowhood.[40,42,43] However, for men, greater declines in vegetable (or fruit) intakes were seen among those who were widowed than those seen in men who became divorced or separated.[39,42,43] One explanation for this observed difference may be that widowed women might experience higher levels of life satisfaction, and overall well-being compared with widowed men, who are often less prepared to cope with widowhood in terms of household food responsibilities.[49]

Separation/divorce is clearly a different social life change than the death of a partner in terms of personal control or choice, and it may have more adverse social and economic consequences for women whose gender role has historically been tied to their married status.[42,49] Individuals respond and adapt to marital transitions, such as divorce, in various manners,[50] and men and women may employ distinct coping mechanisms to deal with psychological stressors or experience unique effects from specific marital dissolutions.[51] For example, women may tend to skip meals as a grief reaction,[40] or lose their inclination to cook when they are no longer in a partnership.[29] Conversely, men may encounter challenges due to a lack of food preparation skills, influencing their dietary intake.[29,39] The loss of a life partner can significantly disrupt meal preparation and eating routines, even for individuals accustomed to cooking.[52] Moreover, cultural differences should be taken into consideration, as gender roles may vary in different societies. For instance, divorce has a social stigma that can present significant challenges for women around the world.[53] Consequently, women who have undergone divorce may encounter numerous social and economic difficulties, as this marital transition can be seen as a deviation from conventional gendered norms, which in turn could disrupt healthy habits, including FV intake.

This review also found limited evidence for either remaining unmarried or becoming married being associated with changes in FV intake. Findings of no association were likely due to the heterogeneous "unmarried" category, which included individuals who were divorced, widowed, or single. Each of these subgroups represents a different social life experience and transition, with its own consequences for social or economic resources and benefits for healthy aging. Differences in health-promoting resources across the "unmarried" categories relate to living arrangements, extent of social networks, and level of active involvement in social activities.[54] Assessing the changes in separate "unmarried" categories (leaving/entering/staying in marriage) is important for better understanding of the association between each distinct social phenomena and changes in diet in aging women and men. Current research obscures this diversity by combining all unmarried categories, with one exception assessing the subtypes of "remaining unmarried."[42] However, that study did not assess whether the dietary changes were associated with different subgroups of the group who "entered marriage" (formerly divorced, formerly widowed, or single). This differentiation is crucial as the experiences and dietary consequences of those who are divorced, widowed, or never married may vary when they re-enter / enter into a marriage. In studies that showed changes in diet, remarriage was associated with an increase in vegetable intake, with more pronounced increases in men. Remaining unmarried was inconsistently associated with dietary changes in both men and women.

Taken together, this review showed stronger adverse changes in healthy eating being associated with marital dissolution, or notable improvements upon remarriage, among men,[39,40,42–44] which aligns with results for other dietary outcomes.[26,48,55–59] Indeed, individuals who are unmarried, especially solitary men, tend to have a lower quality of diet, which could include reductions in FV consumption. Once again, gender roles can shed light on this phenomenon.[25,56,59–61] For example, women in households usually take on the responsibility for meal planning and food preparation,[60] and their marital role often involves caregiving, which can be beneficial to the health of their spouses.[61] Generally, women are often socialized from an early age to be health-conscious and prioritize the well-being of others, such as their family members or loved ones; this would include provision of a high-quality diet. By contrast, this emphasis on actively monitoring and caring for personal and family health is not as prevalent or expected among men.[48,57] Consequently, men may experience greater advantages when transitioning from being unmarried to being married, or when maintaining a married status, compared with men who experience marital dissolution: they receive health benefits that result from caregiving and support to eating healthy food provided by their wives.

There is a lack of longitudinal evidence on the association between changes in other social ties and changes in healthy eating among aging adults. This review finding is surprising, given that the significant role of multiple social ties in promoting health and longevity has been well established,[36,62] while social isolation has been linked to poor overall health and well-being.[63] It is also unexpected, given that aging brings social life transitions as a consequence of employment changes (eg, retirement) as people age, and our search strategy included multiple terms to capture changes in social contact or engagement with co-workers. Notably, social connectedness manifests through various structures, such as living arrangement, social networks or contacts, and social participation, with each serving distinct functions. Living arrangement and social contacts have also been associated with FV intakes of older individuals in cross-sectional studies, with stronger associations among men than women.[26,28] In particular, older adults who have lived alone for 8 or more years were less likely to meet dietary recommendations.[64] Other research that did not meet our inclusion criteria because of a broad age group[65] or lack of exposure to changes in social ties,[66] have also shown that greater levels of social networks and social participation have been linked to higher intakes of FV. The absence of data on changes in other social ties may be due to a strong bias towards functional aspects of social connections (ie, social support), or feelings of loneliness, and also the common use of combining of multiple different social ties (eg, marital status and social activities) into a single composite index of social isolation or social integration.[32] Broadly, previous research shows that higher social isolation is associated with poorer health behaviors, such as low FV intake.[67]

Finally, the review offers valuable insights for program planners and government policymakers to support healthy aging in the context of social life changes and gender inequities in healthy eating habits. A key review finding was that distinct marital transitions were associated with changes in healthy eating habits, with marital loss linked to reductions in FV consumption in aging women and/or men, which indicates that social relationships are important not only for overall health and longevity but also for a key behavioral risk factor. Overall, evidence suggests efforts to promote healthy eating need to be tailored to men experiencing widowhood and women undergoing divorce. The review findings underscored the importance of marital transitions as a likely determinant of healthy eating and the necessity of disaggregated data. Potential interventions of individual nutrition education and

counselling services could be titrated to address the distinct gender-specific marital transitions leading to lower FV in aging women and men. In addition, government health policies and healthy aging strategies could focus on incorporating and funding social prescribing programs, particularly in relation to marital dissolution for older adults to prevent unhealthy eating habits. Some caution in the interpretation of the current evidence is warranted, however. Despite our departure from the prevalent cross-sectional nutrition research on social relationships, in an attempt to provide a better understanding of social ties as determinants of diet, the current literature on the dietary effects of marital transitions among older adults was of medium quality. Due to study quality concerns, the review findings lack specificity for subpopulations of age or socioeconomic status, they may be biased in the reported dietary effects, and they are not representative of non-White or Anglo-American populations. As noted, marital transitions were often measured concurrently with changes in FV intake in the current literature, and this limits the review's interpretation of causal inference. Thus, more robust high-quality prospective studies are needed for evidence-based policy and decision-making on healthy aging strategies and public health nutrition.

This review also offers valuable insights into a critical gap in knowledge for evidence-based policy and interventions about social activities or living arrangement as other possible determinants of diet. Despite cross-sectional research reporting that social networks, social engagement or isolation and shared accommodation are each associated with dietary behaviors, there is a lack of longitudinal evidence for these social ties as possible determinants of diet. Notably, recent public health nutrition efforts and dietary guidelines, such as the new 2019 Canada Food Guide,[68] have highlighted the importance of social connections. This guideline emphasizes the importance of eating together, as this approach can enhance the enjoyment of healthy eating and fosters connections across generations and cultures. Overall, preparing and eating food in the company of others offers people of all ages an opportunity to learn about food and share culinary cultures.[69,70] Moreover, recent studies examining the impact of social prescribing initiatives or interventions on loneliness and social isolation appeared effective in alleviating these concerns.[71,72] Understanding and addressing the specific dietary needs of socially vulnerable groups among aging women and men may lead to healthy eating and ultimately contribute to improved overall health outcomes for all older adults. Given the results of this review, there is great scope for research to determine which social contacts matter for healthy eating habits and for whom.

This systematic review has some limitations. First, it is possible that some relevant literature was missed in gray literature or experimental studies, although both were included in the search. Second, this review focused on FV intake and not on other healthy eating behaviors that may be important when assessing the role of transitions in social ties in changes in healthy eating habits. Third, all included studies came from high-income settings and predominantly white populations, which limits the generalizability of the synthesized evidence to more diverse populations. Finally, some relevant literature may have been missed, as the search terms related to social participation used broad MeSH and thesaurus terms for social activity and not terms for specific types of social activities. This limitation of the search might explain the finding of no longitudinal evidence for social ties other than marital transitions leading to changes in FV intake in aging adults. Nevertheless, this systematic review followed an established rigorous methodology with clear criteria for screening, was performed by 2 independent reviewers, included a comprehensive search of multiple terms for various social ties across 5 bibliometric databases covering interdisciplinary literature from socio-medical sciences, had no date restrictions, and also provided a critical appraisal of the quality of the included studies.

CONCLUSION

Despite the known importance of social ties for health and health behaviors, longitudinal evidence for the social determinants of healthy eating among aging adults remains scarce. Very little literature exists on the role of marital transitions as a critical change in social structures that are prospectively associated with changes in FV intake among adults in mid to later life. It was clear that the direction and magnitude of changes in consumption of fruits or vegetables differed across specific marital transitions, with some gender differences. Much less is known about the timing of marital status changes or changes of other social ties associated with changes in FV intakes. Research to comprehensively examine variations across age subpopulations is also warranted. Firm conclusions about social connections as determinants of diet in aging adults are, therefore, difficult to make. To inform future public health and policy to promote healthy eating and supportive environments, greater attention to this burgeoning research area is needed. Future work should use controlled longitudinal studies, with different exposures of defined periods and multiple health eating measures in various subgroups

of aging women and men. A more nuanced and stronger evidence base is essential in order to make causal inferences about the social context for healthy eating among aging adults.

Author Contributions

A.I.C. designed the study. S.M. developed and conducted the initial search strategy. R.A.M. and T.R.C. contributed to the conception, design, and data interpretation. S.M., R.M.C., R.P., and A.I.C. contributed to screening and study selection. S.M. performed data extraction and quality appraisal. S.M. and A.I.C. wrote the original draft. R.A.M., T.R.C., R.M.C., and R.P. critically reviewed the draft for revisions. All authors read and approved the final version of the manuscript.

Supplementary Material

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Conflict of Interest

None declared.

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