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ORIGINAL ARTICLE
Heart failure

Social relationships and the risk of incident heart failure: results from a prospective population-based study of older men

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Aims Limited social relationships, particularly in older adults, have been implicated as a risk factor for cardiovascular disease. However, little is known about the associations between poor social relationships and heart failure incidence.

Methods and results Prospective study of socially representative men aged 60–79 years drawn from general practices in 24 British towns and followed up for a maximum of 18 years. A total of 3698 participants with no previous diagnosis of heart failure were included. Information on social relationships was based on a combination of marital status, living circumstances, and social contacts with friends and family. These provided information on contact frequency, contact satisfaction, and a social relationship score (low to high) combining frequency and satisfaction with contact. Heart failure included both incidents non-fatal heart failure and death from heart failure. Among 3698 participants, 330 developed heart failure. Men with low compared to high frequency of contact with family and friends had an increased risk of incident heart failure [hazard ratio (HR) 1.59, 95% confidence interval (CI) 1.15–2.18]; this remained statistically significant after adjustment for social class, behavioural, and biological risk factors. Low compared to high scores for satisfaction with contacts was associated with increased risk of heart failure (adjusted HR = 1.54; 95% CI 1.14–2.07). Lower social relationship scores (combining frequency and satisfaction with contact) were associated with greater risk of incident heart failure (adjusted HR = 1.38, 95% CI 1.02–1.87). Marital status and living alone were not significantly associated with heart failure.

Conclusion Weaker social relationships appear to increase the risk of developing heart failure in older age. Further research is needed to investigate pathways underlying these associations and to test whether interventions to strengthen social relationships can reduce the risk of heart failure.

Keywords social isolation • heart failure

Introduction

Cardiovascular disease is of particular concern as people age, with high incidence in older populations. Although death rates from cardiovascular disease have fallen, in recent years, it remains the top cause of death for males and the second most common for females in the UK, accounting for 25% of all deaths.[1,2] Heart failure is a common cardiovascular disease manifestation, affecting those in the later

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decades of life and resulting in high morbidity and poor quality of life.[3] With an ageing population, the absolute number of heart failure cases is rising. Heart failure currently accounts for £625 million of the NHS annual budget, this is likely to rise making it a key area of focus for the healthy ageing agenda.[4,5]

As people age, our social networks shrink as a consequence of natural life events such as widowhood, death of friends, and reduced ability to travel.[6] The social relationships which create our social networks influence health status by encouraging social engagement.[7] Analysis of the English Longitudinal Study of Ageing showed that over half of 80 years olds reported a lack of companionship.[8] It is predicted that if loneliness rates among older people remain unchanged, expected demographic changes will see the number of lonely older people increase by 40% over the next 10 years.[9] Lack of social engagement can have adverse consequences on both the health and function of individuals as well as widespread community effects through the use of public services. Those with a weaker social network are more likely to visit a general practitioner or accident and emergency unit, need hospitalization, and enter local authority funded residential care.[10] Social engagement has been proposed to influence health outcomes through 'direct' and 'indirect' effects. 'Direct' effects are changes to the structural, immune and neuroendocrine system independent of health behaviours. The 'indirect' effects are the higher engagement in health damaging behaviours, such as smoking and low physical activity, seen in those with low social engagement.

Social engagement has been shown to have positive effects on health outcomes for multiple physical and mental health conditions.[11–13] There is a growing body of evidence showing that poor social engagement in older age is associated with cardiovascular disease, such as myocardial infarction and stroke.[14–18] However, the literature on incident heart failure is limited. Only one study, to our knowledge, has investigated the association between social isolation and the incidence of heart failure, reporting an increased risk of heart failure in those with higher rather than lower social isolation.[19] That study did not, however, adjust for covariables such as physical activity, cholesterol levels, and biomarkers [e.g. C-reactive protein, von Willebrand factor (vWF)], all of which could be mechanisms to influence heart failure incidence, and also associated with social factors.[20,21] The present study investigated the association between social relationships, captured through multiple measures, and heart failure incidence, whilst adjusting for biological and behavioural covariables in a community-dwelling sample of older British men.

Methods

The British Regional Heart Study is a longitudinal study comprising men from 24 British towns representing all major British regions with populations between 50 000 and 100 000 in 1974.[22] The towns were representative of the region in terms of cardiovascular mortality and socioeconomic activity. A total of 7735 men were recruited from general practices in the period 1978–80 when the men were aged 40–59 years, the cohort has been followed up since. All men provided written informed consent. Ethical approval was provided by local research ethics committees throughout. Between 1998 and 2000, the men were invited for a follow-up examination when they were aged between 60 and 79 years. Follow-up examination included a lifestyle and medical questionnaire, a physical examination and a blood sample after a minimum 6 h fast using the Sarstedt Monovette system. The follow-up of the cohort study was to investigate the influence of a range of factors, including social factors, on cardiovascular disease. A total of 4252 (77%) men attended the examination. We excluded 554 men with prevalent heart failure or previous myocardial infarction, leaving 3698 men for analysis.

Measures of social relationships

Subjects were asked four questions in the questionnaire about their social relationships: (i) frequency of contact with family, friends, and neighbours: how often they saw or spoke to each of their children/siblings, and friends/neighbours; (ii) satisfaction with contact with family, friends, and neighbours: whether they perceived that the amount of contact they had in these relationships was sufficient or not; (iii) marital status (married, divorced/separated, widowed, single, and other); and (iv) whether they lived alone (living alone, living with partner/spouse, living with family member, and living with other people); shown in *Figure 1*.

These questions were used to capture two dimensions of social relationships, as proposed by Valtorta *et al.*,[23] in order to determine what aspect of social relationships might be important: (i) measurement of structure and/or function of social relationship (e.g. number of social contacts), and (ii) degree of subjectivity of respondents on their social relationships (e.g. perceived adequacy of social relationships). The questions on 'frequency of contact', marital status and living arrangement were used to explore the structure and involvement in relationships. The questions on 'satisfaction with contact' were used to explore the function, perceived adequacy and quality/depth of relationships reported by participants.

Covariables

Cardiovascular risk factor data collected for this cohort has previously been described.[24,25] Risk factors considered were socioeconomic position based on occupational social class from the Registrar General's Social Class Classification; behavioural factors included smoking, physical activity, and alcohol intake; biological markers [body mass index (BMI), systolic blood pressure (SBP), cholesterol, and high-density lipoprotein (HDL)]; health status markers [forced expiratory volume in 1 s (FEV_1), estimated glomerular filtration rate (eGFR), history of diabetes, history of vascular disease, and use of blood pressure medication for hypertension]; biomarkers associated with heart failure [N-terminal pro-brain natriuretic peptide (NT-proBNP), C-reactive protein (CRP), and vWF]. Prevalent diabetes was based on fasting glucose ≥7 mmol/L or self-reported diabetes. Cardiovascular disease included any self-reported doctor diagnosis of coronary artery disease, peripheral vascular disease, or stroke.

Follow-up and incident heart failure

The cohort has been followed-up through 2 yearly reviews of General Practitioner records for morbidity and through the National Health Service Central Register for mortality. Maximum follow-up period for this analysis was 18 years (from 1998 to June 2016); participants were followed till incident heart failure event, death, or last record review date.

Incident heart failure included both incidents non-fatal heart failure and death from heart failure (ICD 9th revision code 428 or ICD 10th revision I28). Diagnosis was based on a doctor-confirmed diagnosis of heart failure from General Practice records (including hospital and clinic correspondence). All cases were verified by a review of clinical information from primary and secondary care records to ensure diagnosis was consistent with current recommended heart failure diagnosis. This classification of heart failure has been previously validated.[26]

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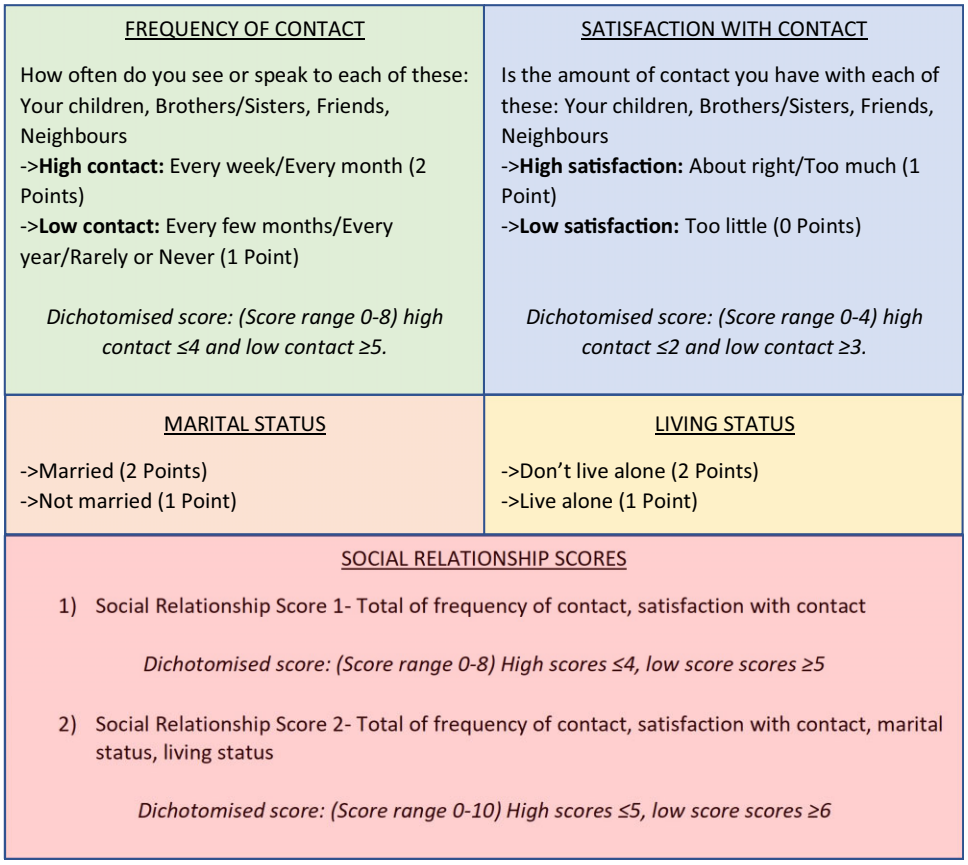

Figure 1 Social relationships measures.

Statistical analysis

Baseline demographics were described using the mean and standard deviation, the median and interquartile range, or percentages. C-reactive protein and NT-proBNP were positively skewed, these were log-transformed for analysis.

Measures of social relationships

Figure 1 summarizes the measures of social relationships used. A 'Frequency of Contact' score was generated based on the number of contacts with social network members (children, siblings, friends, and neighbours). Those with contact at least every month had a high contact score, and those with contact every few months or less had a low contact score. The combined score across social networks ranged from 1 to 8, which was then dichotomized into 'high frequency of contact' (scores ≤4) and 'low frequency of contact' (scores ≥5).

A 'Satisfaction with Contact' score was generated based on the perceived adequacy of contact with social network members (children, siblings, friends, and neighbours). Those with 'about right' or 'more contact' had a high satisfaction score, and those with 'too little' contact a low score. The combined score ranged from 0 to 4, which was then dichotomized into 'high satisfaction with contact' (scores ≤2) and 'low satisfaction with contact' (scores ≥3).

A combined 'Social Relationship 1' score was created from the dichotomized 'Frequency of Contact' and 'Satisfaction with Contact' scores. The score ranged from 0 (highest) to 8 (lowest). This was dichotomized into high (scores ≤4) and low (scores ≥5) social relationship scores.

A combined 'Social Relationship 2' score was created by combining 'Frequency of Contact', 'Satisfaction with Contact', marital status, and living alone status. The score ranged from 0 (highest) to 10 (lowest). This was dichotomized into high (scores ≤5) and low (scores ≥6) social relationship scores. Marital status (currently married or not currently married) and living alone (lives alone/does not live alone) were both dichotomous variables.

Models

Cox proportional hazard models were used to examine the risk of incident heart failure with each of the social relationship measures. Hazard ratios (HRs) and 95% confidence intervals (CIs) were obtained. Five Cox models were created, which adjusted sequentially for known risk factors.[24,25] Model 1 adjusted for age. Model 2 included age and social class. Model 3 was further adjusted for behavioural factors (smoking, physical activity, and alcohol intake) and biological factors (BMI, SBP, cholesterol, and HDL). Model 4 was further adjusted for markers of health status (history of diabetes, history of vascular disease, use of blood pressure medication for hypertension, FEV_1, and eGFR); Model 5 was additionally adjusted for biomarkers associated with heart failure (NT-proBNP, CRP, and vWF). Social class (six levels), history of cardiovascular disease (two levels), smoking intake, physical activity level, alcohol intake, diabetes status (two levels), vascular disease status, and use of blood pressure medication were fitted as categorical variables in the models. Age, BMI, SBP, cholesterol, HDL, FEV_1, eGFR, NT-proBNP, CRP, and vWF were fitted as continuous variables.

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Table 1 Baseline characteristics of the study population

	Total in cohort	Incident heart failure (*n* = 338)	No heart failure (*n* = 3360)	*P*-value
Age, mean (SD)	3698	69.8 (5.4)	68.4 (5.5)	<0.0001
Manual worker, *N* (%)	1868	171 (51%)	1697 (51%)	0.97
Never smoked, *N* (%)	1123	92 (27%)	1031 (31%)	0.17
Heavy drinker, *N* (%)	107	15 (4%)	92 (3%)	0.32
Physically inactive, *N* (%)	360	31 (9%)	329 (10%)	0.30
BMI, kg/m^2, mean (SD)	3684	27.7 (3.9)	26.8 (3.6)	<0.0001
Obese: BMI > 30 kg/m^2, *N* (%)	606	80 (24%)	526 (16%)	<0.0001
SBP, mmHg, mean (SD)	3683	153.7 (25.0)	149.9 (23.9)	<0.01
Hypertension: SBP >140 mmHg, *N* (%)	2415	241 (72%)	2174 (65%)	0.00
Hypertension: DBP >90 mmHg, *N* (%)	1203	115 (34%)	1088 (33%)	0.04
Cholesterol level, mmol/L, mean (SD)	3522	6.0 (1.0)	6.1 (1.1)	0.20
Hypercholesterolaemia: cholesterol >5 mmol/L, *N* (%)	3009	267 (83%)	2742 (86%)	0.03
HDL level, mmol/L, mean (SD)	3500	1.3 (0.4)	1.3 (0.3)	0.14
Diabetic, *N* (%)	3694	45 (13%)	349 (10%)	0.09
Vascular disease, *N* (%)	3617	73 (22%)	487 (15%)	<0.001
Taking blood pressure medication for hypertension, *N* (%)	3648	109 (33%)	773 (23%)	<0.0001
eGFR, mL/min, mean (SD)	3524	71.0 (12.7)	73.1 (12.6)	<0.01
FEV_1, L, mean (SD)	3661	2.4 (0.7)	2.6 (0.7)	<0.0001
NT-proBNP, pg/mL, median (IQR)	3304	148.5 (307.5)	79.0 (114)	<0.0001
CRP, mg/L, median (IQR)	3544	2.0 (2.6)	1.5 (2.5)	<0.01
vWF, IU per DI, mean (SD)	3567	142.1 (48.0)	137.7 (45.7)	0.10

BMI, body mass index; CRP, C-reactive protein; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; FEV_1, forced expiratory volume in 1 s; HDL, high-density lipoprotein; NT-proBNP, N-terminal pro-brain natriuretic peptide; SBP, systolic blood pressure; vWF, von Willebrand factor.

All analysis was carried out using SAS version 9.4.

Results

Prevalence and baseline characteristics

In total, 3698 men were followed up for a median of 15.9 years (Q1 8.5 years; Q3 17.2 years), and during this time, 330 (8.9%) incident heart failure events occurred. Baseline characteristics are described in *Table 1* for those with and without incident heart failure. Age (69.8 vs. 68.4 years), BMI (27.7 vs. 26.8 kg/m^2), obesity (24% vs. 16%), SBP (153.7 vs. 149.9 mmHg), the proportion of those with pre-existing vascular disease (22% vs. 15%), and proportion taking blood pressure medication (33% vs. 23%) were greater in those with incident heart failure compared to those without. eGFR (71.0 vs. 73.1 mL/min) and FEV_1 (2.4 vs. 2.6 L) levels were lower in those with incident heart failure. NT-proBNP (148.5 vs. 79.0 pg/mL), CRP (2.0 vs. 1.5 mg/L), and vWF (142.1 vs. 137.7 IU per DI) were higher in those with incident heart failure.

Social relationship measures and risk of heart failure

Table 2 shows the prevalence of social relationship measures for those with and without incident heart failure. There was a higher prevalence of low 'frequency of contact' scores in those who developed heart failure (13.5%) compared to those who did not develop heart failure (9.3%; $P = 0.016$). Satisfaction with contact showed a similar pattern of lower perceived satisfaction in those who developed heart failure than those without (Heart failure 17.6% vs. No heart failure 11.9%; $P = 0.005$). Those with heart failure had higher levels of low combined Social Relationship scores, both for Social Relationship Score 1 (Heart failure 19.82% vs. No heart failure 14.85%; $P = 0.016$) and Social Relationship Score 2 (Heart failure 18.64% vs. No heart failure 14.61%; $P = 0.048$). Living and marital status showed no independent association with heart failure incidence.

Table 3 presents the adjusted HRs (95% CI) for incident heart failure by different social relationship measures, individually and as combined scores.

Frequency of contact

Those with lower compared to higher scores of frequency of contact had a significantly higher risk of developing heart failure in age-adjusted analysis (Model 1 age-adjusted HR 1.59, 95% CI 1.15–2.18). This was not significant once adjusted for age, social class, behavioural factors, health status, and biomarkers (Models 4 and 5).

Satisfaction with contact

Those with lower scores of satisfaction with contact had a significantly higher risk of developing heart failure in age-adjusted analysis (Model 1 HR 1.54, 95% CI 1.14–2.07). This was not significant once adjusted for age, social class, behavioural factors, health status, and biomarkers (Models 4 and 5).

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Table 2 Measures of social relationship stratified by heart failure incidence

	No heart failure, *n* (%)	Incident heart failure, *n* (%)	*P*-value
Frequency of contact score (*n* = 3605)			
Low, *n* = *350 (9.7%)*	306 (9.33)	44 (13.46)	*0.016*
High, *n* = *3255 (90.3%)*	2972 (90.67)	283 (86.54)	
Satisfaction with contact score (*n* = 3289)			
Low, *n* = *409 (12.4%)*	357 (11.9)	52 (17.6)	*0.005*
High, *n* = *2880 (87.6%)*	2636 (88.1)	244 (82.4)	
Living status (*n* = 3589)			
Live alone, *n* = *407 (11.3%)*	362 (11.1)	45 (13.8)	*0.14*
Live with others, *n* = *3182 (88.7%)*	2901 (88.9)	281 (86.2)	
Marital status (*n* = 3582)			
Not married, *n* = *548 (15.3%)*	490 (15.0)	58 (17.9)	*0.181*
Married, *n* = *3034 (84.7%)*	2767 (85.0)	267 (82.2)	
Social relationship score 1[a] (*n* = 3698)			
Low, *n* = *566 (15.3%)*	499 (14.85)	67 (19.82)	*0.016*
High, *n* = *3132 (84.7%)*	2861 (85.15)	271 (80.18)	
Social relationship score 2[b] (*n* = 3698)			
Low, *n* = *554 (15.0%)*	491 (14.61)	63 (18.64)	*0.048*
High, *n* = *3144 (85.0%)*	2869 (85.39)	275 (81.36)	

[a]Social relationship score 1 = 'Frequency of Contact' score + 'Satisfaction with Contact' score.
[b]Social relationship score 2 = 'Frequency of Contact' score + 'Satisfaction with Contact' score + marital status + living alone status.

Social relationship scores

Those with a low Social Relationship Score 1 had a significantly greater risk of developing heart failure in age-adjusted analysis (Model 1, HR 2.03; 95% CI 1.34–3.06). The association remained significant after additional adjustment for social class, behavioural factors, biological factors, health status, and biomarkers (Model 5, HR 1.38, 95% CI 1.02–1.87). Similarly, Social Relationship Score 2, which includes marital status and living alone, showed that those with low scores had a significantly greater risk of developing heart failure in age-adjusted analysis (Model 1, HR 2.40; 95% CI 1.44–3.97). The association remained statistically significant after additional adjustment for social class, behavioural factors, biological factors, health status, and biomarkers (Model 5, HR 1.23, 95% CI 0.90–1.69).

Men who were unmarried and lived alone showed a slightly increased risk of heart failure, although this did not reach statistical significance.

Discussion

This prospective study investigated the associations between measures of social relationships and the risk of incident heart failure over a maximum 18-year follow-up in a general population sample of British men aged 60–79 years. These associations were also adjusted for a range of established cardiovascular risk factors including blood pressure, BMI, diabetes, and cholesterol. We found that lower social relationship scores, examined both as individual and combined measures, were associated with an increased risk of developing heart failure. Our findings suggest that social relationships are an independent predictor of heart failure with increased risk having remained after adjustment for a variety of socioeconomic, behavioural, biological, and health status factors.

Comparison with other studies

The majority of previous studies have examined the association between social relationships and heart failure retrospectively. These have shown that those with weaker social relationships have a higher incidence of heart failure.[27–29] We know of only one prospective study, by Cené *et al.*,[19] to have examined the association between social relationships and heart failure incidence. This study in a younger population of men and women showed that weaker social relationships, defined as social isolation, was an independent risk factor for incident heart failure.[19] These findings are similar to our study. However, this previous study did not adjust for as wide a range of confounders as our study. Our study is the first, to our knowledge, to prospectively investigate this association whilst adjusting for a wide range of factors known to influence the underlying mechanisms of heart failure; the factors we adjusted for included behavioural and biological risk factors, including biomarkers such as CRP and vWF.

It has been reported in previous literature that marital status and family support may be associated with poorer outcomes in heart failure patients.[30] Cardiovascular death was greatest in single, never married men and in separated/divorced woman compared to married; this is felt to be attributed to decreased support for self-care.[31] However there have also been contrary reports when Watkins *et al.*[32] showing no association between clinical outcomes and marital status in heart failure patients. There is little in the literature on incident heart failure development and marital and living status; our findings showed a slight increase in risk of heart failure in unmarried and living alone men but this did not reach statistical significance. Binary evaluations of social relationships such as marital or living status have been shown to be less predictive of health outcomes.[33] These binary measures may not fully capture the complex nature of social

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Table 3 Cox proportional hazards regression analysis of the associations between social relationship measures and incident heart failure, presenting hazard ratios (HRs) and 95% confidence intervals (CIs)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Adjusted for age		Adjusted for age and social class		Adjusted for age, social class, behavioural factors, and biological factors[a]		Adjusted for age, social class, behavioural factors, biological factors, and health status[a]		Adjusted for age, social class, behavioural factors, biological factors, health status, and biomarkers[a]	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Marital status										
Married	1.00		1.00		1.00		1.00		1.00	
Unmarried	1.30	0.98–1.73	1.30	0.97–1.72	1.24	0.91–1.68	1.17	0.85–1.61	1.04	0.75–1.45
Living alone status										
Living with others	1.00		1.00		1.00		1.00		1.00	
Living alone	1.38	1.00–1.89	1.38	1.01–1.89	1.33	0.94–1.86	1.23	0.86–1.76	1.08	0.74–1.57
Frequency of contact score										
High contact	1.00		1.00		1.00		1.00		1.00	
Low contact	1.59	1.15–2.18	1.57	1.14–2.17	1.48	1.04–2.09	1.41	0.98–2.03	1.34	0.94–1.99
Satisfaction with contact score										
High satisfaction	1.00		1.00		1.00		1.00		1.00	
Low satisfaction	1.54	1.14–2.07	1.54	1.14–2.07	1.44	1.04–1.98	1.26	0.90–1.77	1.28	0.90–1.81
Social relationship score 1[b]										
High social engagement	1.00		1.00		1.00		1.00		1.00	
Low social engagement	2.03	1.34–3.06	2.01	1.33–3.04	2.03	1.32–3.13	2.01	1.29–3.12	1.38	1.02–1.87
Social relationship score 1[b] continuous score (per 1 unit increase)	0.73	0.60–0.88	0.73	0.60–0.89	0.76	0.61–0.93	0.80	0.64–1.00	0.80	0.64–1.00
Social relationship score 2[c]										
High social engagement	1.00		1.00		1.00		1.00		1.00	
Low social engagement	2.40	1.44–3.97	2.38	1.43–3.95	2.13	1.24–3.68	2.01	1.14–3.55	1.23	0.90–1.69
Social relationship score 2[c] continuous score (per 1 unit increase)	0.81	0.72–0.91	0.81	0.72–0.91	0.83	0.73–0.94	0.86	0.75–0.98	0.89	0.77–1.02

[a]*Behavioural factors*: smoking, physical activity, and alcohol intake; *Biological factors*: BMI, SBP, cholesterol, and HDL; *Health status*: FEV_1, eGFR, history of diabetes, history of vascular disease, and use of blood pressure medication for hypertension; *Biomarkers*: NT-proBNP, CRP, and vWF.
[b]Social relationship score 1 = 'Frequency of Contact' score and 'Satisfaction with Contact' score.
[c]Social relationship score 2 = 'Frequency of Contact' score + 'Satisfaction with Contact' score + marital status + living alone status.

relationships, for instance one can live alone and have an active social life. Our combined Social Relationship Scores are as such a better reflection of social relationships status and heart failure incidence.

Strengths and limitations

The strengths of this study are a large representative sample of British older males followed up for a long period for validated heart failure outcomes, and with detailed measures on a range of confounders. Our cohort has a high follow-up rate of 98% enabling very low attrition rates. The use of the Valtorta *et al.*[23] classification system for social relationships has allowed us to capture different dimensions of social relationships; including structure, function, and perceived adequacy. However, social relationship measures were captured at one point in time and changes during the follow-up period cannot be ruled out. A limitation of the study is that the participants are all male and predominantly of White ethnicity, limiting the generalizability of our findings to women and other ethnic groups. Although the study had a high response rate, the possibility of survivor bias remains, such that those with more severe disease, from lower socioeconomic groups, or with weaker social relationships would be less likely to have participated in the study. Although we adjusted for a number of covariates, other possible underlying risk factors were not taken into account, such as orthostatic hypotension (leading to falls), sleep duration/quality, and frailty, which are associated with heart failure and also with social relationships in older adults.[34–36] We acknowledge that a number of associations were tested and this has the risk of potentially increasing false-positive results.

Implications and conclusions

These findings have important potential implications for public health practice and policy. Further work is required to test whether interventions aimed at strengthening social relationships among older people reduce the risk of heart failure. The impact of the coronavirus

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disease-19 (COVID-19) pandemic should also be factored into future research. Risk of developing heart failure increases substantially with age. Age has also been identified as a risk factor for severe complications from COVID-19 and consequentially many have advised their older populations to self-isolate for prolonged periods.[37–40] Alongside self-isolation many sources of social contact for older people have been closed during the pandemic, and older people are also less likely to use online forms of communication to maintain social relationships further limiting their social contacts.[37] While isolation measures provide clear short-term health benefits during the pandemic the indirect effects of prolonged social isolation may have substantial long-term physical and mental health impacts.

In summary, our results demonstrate that older adults with weaker social relationships are at increased risk of developing heart failure. While socioeconomic, behavioural, health, and biological factors attenuated this effect, the influence of social relationships, in particular, the combined social relationship score appeared to be independent of these factors.

Our findings have potential implications for the prevention and management of heart failure and builds on the extensive literature into negative health outcomes in those with lower social networks. The ability of people to maintain and engage in social relationships has been heavily impacted by the COVID-19 pandemic which has necessitated periods of prolonged social isolation, particularly amongst older people who are themselves at increased risk of heart failure. The impact of these extensive periods of social isolation are currently unclear but are likely to have worsened disease outcomes for many.

Lead author biography

Dr Aishah Coyte graduated from The University of Glasgow, Scotland with a BSc in medical sciences and an MBChB. She has worked in multiple UK and international health settings and currently works as an Academic Clinical Fellow and Public Health Registrar in Newcastle, England. Her research interests include the role of social determinants of health on chronic health conditions and the impact of health inequalities in adults.

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Conflict of interest: none declared.

Data statement

The data underlying this article will be shared on reasonable request to the correspondingauthor.

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