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Trajectories of perceived social support in acute coronary syndrome

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Abstract

Purpose Perceived social support is known to be an important predictor of health outcomes in patients with acute coronary syndrome (ACS). This study investigates patterns of longitudinal trajectories of patient-reported perceived social support in individuals with ACS.

Methods Data are from 3013 patients from the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease registry who had their first cardiac catheterization between 2004 and 2011. Perceived social support was assessed using the 19-item Medical Outcomes Study Social Support Survey (MOS) 2 weeks, 1 year, and 3 years post catheterization. Group-based trajectory analysis based on longitudinal multiple imputation model was used to identify distinct subgroups of trajectories of perceived social support over a 3-year follow-up period.

Results Three distinct social support trajectory subgroups were identified, namely: "High" social support group (60%), "Intermediate" social support group (30%), and "Low" social support subgroup (10%). Being female (OR = 1.67; 95% CI = [1.18–2.36]), depression (OR = 8.10; 95% CI = [4.27–15.36]) and smoking (OR = 1.70; 95% CI = [1.23–2.35]) were predictors of the differences among these trajectory subgroups.

Conclusion Although the majority of ACS patients showed increased or fairly stable trajectories of social support, about 10% of the cohort reported declining social support. These findings can inform targeted psycho-social interventions to improve their perceived social support and health outcomes.

Keywords Perceived social support · Patient-reported outcome · Acute coronary syndrome · Longitudinal trajectories

Introduction

Acute coronary syndrome (ACS) is a traumatic event and a common cause for emergency hospital admission [1, 2]. The term ACS refers to a series of acute myocardial ischemic states ranging from unstable angina to non-ST-segment elevation myocardial infarction to ST-segment elevation myocardial infarction [3]. Social support is a multi-faceted concept, typically divided to structural (e.g., living with someone) and functional (e.g., receiving emotional help) support. Social support can be described as assistance and protection given to others, and support from one's family and social network has been found to influence activities associated with symptom management and treatment regimes [4].

The evidence between inadequate social support and higher mortality risk is well documented based on a meta-analytic review, and the overall effect remains consistent regardless of population health status, follow-up period, and

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cause of death [5]. In addition, social support including emotional support, instrumental/tangible support, informational support, and appraisal support has demonstrated influences on disease-related outcomes [4, 6], reported as a significant predictor for myocardial infarction [7, 8] and shaping coping strategies in post-myocardial infarction patients [9, 10]. For example, a recent systematic review and meta-analysis showed that deprived social relationships were associated with a 29% increased risk for the incidence of coronary heart diseases (CHD) based on 11 longitudinal studies [7]. A lack of social support is particularly relevant among the elderly, largely because of the prevalence of the acute and chronic health conditions in this age cohort [9]. Elderly patients represent a significant proportion of those who present with ACS [10], suggesting the importance of examining social support among this cohorts. Furthermore, while the index cardiac catheterization is crucial for the diagnosis and treatment of patients with coronary artery disease [11], understanding social support and the relationship with outcomes of care may alleviate the impact and burden of ACS.

Previous studies have focused on the impact of baseline perceived social support on mortality [12], re-hospitalization, and health-related quality of life (HRQOL) [13–16] in CHD using cross-sectional designs. These studies have identified a variety of demographic, clinical, and behavioral risk factors that associated with perceived social support in patients with CHD. However, patients' perceived social support may change over time, especially months even years after ACS diagnosis, influencing their long-time health outcomes and patterns of healthcare utilization. This is particularly true for the elderly population, since they tend to experience significant life-changing events such as comorbid acute or chronic conditions, loss of a spouse/partner, and retirement. Therefore, it is important to understand variations in social support trajectories over time, factors explaining the heterogeneity in social support trajectories, and strategies to address these variations.

This study evaluates variations in long-term social support trajectories and examine how patients' demographic, clinical, and behavioral characteristics explain these variations in patients' perceived social support trajectories over time, using a large prospective cohort of patients after their first catheterization.

Methods

Data

Study design

The cohort consists of patients with ACS who underwent cardiac catheterization in the Province of Alberta, Canada, captured through the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease (APPROACH) registry [17]. The APPROACH registry started data collection in 1995 and contains detailed demographic and clinical information, including results from catheterization, and is merged biannually with mortality data from the Vital Statistics Registry. Individuals in the APPROACH registry are followed longitudinally after catheterization for assessment of subsequent procedures (i.e., cardiac catheterization, percutaneous coronary intervention [PCI] and coronary artery bypass graft [CABG]), and quality of life in patients who consent to follow-up.

Study population

Eligible patients included all Alberta residents over the age of 18 years who had ACS and underwent a first cardiac catheterization between January 1, 2004 and December 31, 2011, had at least one vessel coronary artery disease, and who consented to be enrolled in the APPROACH registry, and completed at least two assessments of Medical Outcomes Study Social Support Scale. Data collected at catheterization included demographic characteristics, clinical comorbidities, measures of disease severity, and coronary angiography results. Patients were followed within 2 weeks of the first catheterization (baseline), 1 year, and 3 years post afterward to complete follow-up questionnaires including information on MOS scale.

Measures

Medical Outcomes Study Social Support Scale (MOS)

Perceived social support was measured using the MOS, which is a 19-item and self-reported measure of social support [18]. The MOS comprises four domains and an overall score, called overall Social Support Index, which was reported in this study. The domains include emotional/informational support (feedback, guidance and information) with eight items, tangible support (material aid and assistance) with four items, positive social interaction (engaging in entertaining activities with others) with four items, and affectionate support (love and affection) with three items. Each item is designed to be answered on a five-point scale ranging from "none of the time" to "all of the time", with higher values indicating more support. While the score on each domain ranges between 2 and 20, the overall support index ranges between 0 and 100. The MOS has excellent psychometric properties: good internal consistency (Cronbach's alpha ranged from 0.90 to 0.97) and composite reliability (ranging from 0.93 to 0.97) for all dimensions

including emotional/informational support, tangible support, positive social interaction, and affectionate support [18–20].

Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale (HADS) is a self-completed instrument consisting of 14 items including seven-item anxiety (HADS-A) and depression (HADS-D) subscales [21]. Each subscale is comprised of seven items rated on 4-point Likert scales and scored as 0–3 [22]. The scores for each HADS subscale range from 0 to 21, with higher score suggesting more symptoms indicative of significant levels of anxiety and/or depression. Consistent with the previous research, it was dichotomized as none to mild depression (HADS score < 11) and moderate to severe depression (HADS score ≥ 11) [23]. HADS has undergone extensive reliability and validity testing in different chronic conditions and has been widely validated in cardiac patients and shown to have good internal consistency (Cronbach's alphas > 0.81) and other psychometric properties [21].

Statistical analysis

Sample characteristics were reported using means, standard deviations, and frequency distributions. Participants with complete data and those without complete data (i.e., patients with 2 MOS) were compared with patients with complete data. Longitudinal multiple imputation model based on Markov Chain Monte Carlo (MCMC) method was used to adjust for missing overall MOS scores. The MCMC method was used because it is robust to missing data in non-normal data (for binary and categorical variables) [24, 25]. The MCMC method uses a single chain to produce five imputations. It completes 200 burn-in iterations before the first imputation and 100 iterations between imputations. The posterior mode computed from the EM algorithm with a non-informative prior was used as the starting values for the MCMC method. Each multiple imputation model adjusted for explanatory variables such as age, gender, body mass index (BMI), depression, anxiety, treatment decisions, smoking status, hypertension, hyperlipidemia, diabetes mellitus, prior myocardial infarction (MI), prior revascularization procedure, calendar year of catheterization, hospitals of catheterization, coronary anatomy, and left ventricular ejection fraction, and other significant factors associated with the missing pattern [26, 27]. Group-based trajectory analysis was used to characterize different patterns of overall social support trajectories over time [28–32]. This method identifies latent subgroups of individuals with similar social support change patterns using a maximum likelihood estimation method. Fit statistics, such as Bayesian information criterion, group membership probability (no less than 5%), and average posterior group membership probabilities (no less than 70%) were used for model selection and to determine the optimal number of trajectory subgroups. Specifically, model selection started with one quadratic group and more groups were added if the model with the added groups had a better fit based on the above criteria. Successive models with between two and four trajectories were tested. Within the model selection, the quadratic terms were not kept since significant coefficients were not significant at the 0.05 significance level. The linear terms were held whether they were significant or not [32]. For the purpose of representativeness, the group membership probability for each group was set to be not smaller than 5%, to avoid sparse cells for subsequent subgroup analyses.

Consistent with previous recommendations about the optimal number of imputations [33], the group-based trajectory analysis was implemented using five imputed data sets obtained from the multiple imputation model. The estimated subject-specific probabilities of group membership and overall group memberships were derived by combining the imputation-specific estimates of these probabilities using Rubin rule [27]. Chi square test and analysis of variance were used to evaluate univariate associations between categorical and continuous patients' characteristics and trajectory subgroup membership, respectively. Multinomial logistic regression was used to further assess the associations between trajectory subgroup membership and patients' demographic, clinical, and psychosocial characteristics. The adjusted associations were reported using odds ratio (OR) and 95% confidence interval (95% CI). All results were considered statistically significant with a two-sided p value of less than 0.05.

These analyses were conducted by a PhD trainee with expertise in biostatistics (MW) and supervised by a Senior Biostatistician with expertise in latent-variable modeling methods for patient-reported outcomes. All the analyses were conducted in SAS v9.4 [34].

Results

Table 1 describes the characteristics of the 3036 patients in this study cohort including patients with complete MOS data and those with two MOS records out of three repeated measurements; overall the mean age was 64 years (SD = 10.8), 80% were male, and 70.6% had at least two comorbid conditions. For patients with complete MOS data, the mean age was 65 years (SD = 10.4), 79% were male, and 70% had at least two comorbid conditions; similarly, for patients with two MOS records, the mean age was 64 years (SD = 10.9), 80% were male, and 70% had at least two comorbid conditions.

Trajectory analysis revealed three distinct social support trajectory subgroups for patients with at least two

Table 1 Baseline characteristics of study participants

Patients' characteristics	Overall $N=3036$	Patients with 2 MOS $N=2008$	Patients with 3 MOS $N=1028$	*P*-value
Age, y, mean (SD)	64.4 (10.8)	64.1 (10.9)	64.9 (10.4)	0.06
Male sex—*n* (%)	2426 (79.9)	1612 (80.3)	814 (79.2)	0.48
Affectionate support	82.9 (26.5)	82.8 (27.0)	83.2 (25.7)	0.65
Tangible (or instrumental) support	79.6 (26.7)	79.1 (27.0)	80.4 (26.3)	0.21
Positive social interaction	78.8 (25.8)	78.3 (26.2)	79.5 (25.2)	0.24
Emotional/informational support	72.8 (25.1)	72.2 (25.5)	73.9 (24.2)	0.08
Total social support	76.5 (22.8)	76.0 (23.3)	77.5 (22.0)	0.10
Index intervention within a year of cath—*n* (%)				0.27
No intervention received	302 (10.0)	206 (10.3)	96 (9.3)	
PCI	2261 (74.5)	1477 (73.6)	784 (76.3)	
CABG	473 (15.6)	325 (16.2)	148 (14.4)	
Left ventricular ejection fraction—*n* (%)				0.06
> 50	1673 (61.9)	1083 (60.3)	590 (65.1)	
35–50	572 (21.2)	396 (22.1)	176 (19.4)	
20–34	109 (4.0)	80 (4.5)	29 (3.2)	
< 20	14 (0.5)	12 (0.7)	2 (0.2)	
Not done	335 (12.4)	225 (12.5)	110 (12.1)	
Indication for cardiac cath—*n* (%)	2277 (75.0)	1518 (75.6)	759 (73.8)	0.37
MI	734 (24.2)	476 (23.7)	258 (25.1)	
Unstable	25 (0.8)	14 (0.7)	11 (1.1)	
Other				
HADS-depression	3.6 (3.1)	3.7 (3.2)	3.3 (2.8)	< 0.01
HADS-anxiety	5.1 (3.7)	5.3 (3.8)	4.9 (3.5)	0.01
HADS-depression—*n* (%)				0.14
Score ≥ 11	75 (3.3)	57 (3.7)	18 (2.5)	
BMI	28.7 (4.8)	28.8 (4.9)	64.9 (10.4)	0.10
BMI[a]—*n* (%, kg/m^2)				0.83
Underweight (< 22)	132 (4.8)	88 (4.8)	44 (4.7)	
Healthy weight (22–27)	960 (34.8)	627 (34.4)	333 (35.6)	
Overweight (> 27)	1667 (60.4)	1108 (60.8)	559 (59.7)	
Smoking—*n* (%)	741 (24.4)	517 (25.8)	224 (21.8)	0.02
The number of comorbidities—*n* (%)				0.30
0	217 (7.2)	147 (7.3)	70 (6.8)	
1	670 (22.1)	442 (22.0)	228 (22.2)	
2	1099 (36.2)	711 (35.4)	388 (37.7)	
3	650 (21.4)	432 (21.5)	218 (21.2)	
4	286 (9.4)	201 (10.0)	85 (8.3)	
≥ 5	114 (3.8)	75 (3.7)	39 (3.8)	

NB The numbers presented are means and standard deviations except indicated otherwise, *PCI* percutaneous coronary intervention, *CABG* coronary artery bypass graft, *MED* medical treatment, *BMI* body mass index, *HADS* Hospital Anxiety and Depression Scale, *MI* myocardial infarction

[a]BMI classification was based on healthy weight range for people over age 65

repeated assessments who survived (Fig. 1). About 60% of the patients had consistently "*High*" social support trajectories, with slightly decreasing trends post catheterization (the average of MOS was 87.8 at baseline and 85.9 at 3-year follow-up). The "Intermediate" trajectory group (about 30% of the cohort) consist of patients with moderate social support, with slightly decreasing trend over time (the average of MOS was 65.2 at baseline and 62.1 at 3-year follow-up). The "Low" trajectory group (10% of patients) had lower social support, with constantly decreasing trends over the 3 years after catheterization (the average of MOS was 35.6 at baseline and 29.4 at 3-year

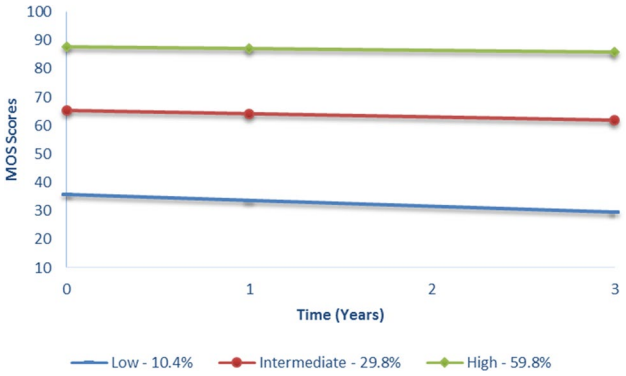

Fig. 1 Longitudinal social support trajectories based on MOS scores using multiple imputation

follow-up). The mean posterior probability for each trajectory group exceeded 0.80, which confirmed that the three latent trajectory groups were optimal for our data. As a sensitivity analysis to assess the robustness of our findings to missing, results of the group-based trajectory analysis based on available data (non-imputed data) yielded three distinct subgroups with trajectory patterns and mean posterior probabilities similar to those described for the multiply imputed data (described above, details can be found in "Appendix").

Table 2 describes the demographic, clinical, and psychosocial characteristics of patients in each MOS trajectory subgroup. Univariate analyses revealed significant differences among the MOS trajectory subgroups with respect to sex

Table 2 Characteristics of study participants by MOS trajectory subgroup

Patients' characteristics	"Low" $N=307$	"Intermediate" $N=861$	"High" $N=1868$	p Values
Age	63.8 (11.2)	64.8 (10.8)	64.3 (10.6)	0.35
Male sex—*n* (%)	231 (75.2)	643 (74.7)	1552 (83.1)	< 0.01
Affectionate support	38.9 (30.0)	71.9 (27.0)	95.0 (12.2)	< 0.01
Tangible (or instrumental) support	38.4 (29.2)	67.4 (26.7)	91.7 (14.5)	< 0.01
Positive social interaction	38.9 (25.9)	66.5 (24.1)	90.6 (15.6)	< 0.01
Emotional/informational support	32.4 (21.3)	60.2 (21.6)	85.1 (15.6)	< 0.01
Total social support	34.0 (17.5)	63.1 (18.3)	89.1 (11.0)	< 0.01
Index intervention within a year of cath—*n* (%)				0.61
No intervention received	29 (9.5)	96 (11.2)	177 (9.5)	
PCI	227 (73.9)	640 (74.3)	1394 (74.6)	
CABG	51 (16.6)	125 (14.5)	297 (15.9)	
Left ventricular ejection fraction—*n* (%)				0.66
> 50	170 (61.4)	472 (61.5)	1031 (62.2)	
< 50	68 (24.6)	209 (27.2)	418 (25.2)	
Not done	39 (14.1)	87 (11.3)	209 (12.6)	
Indication for cardiac cath—*n* (%)				0.18
MI	238 (77.5)	659 (76.5)	1380 (73.9)	
Unstable angina or other	69 (22.5)	202 (23.5)	488 (26.1)	
HADS-depression	5.6 (3.8)	4.5 (3.2)	2.8 (2.6)	< 0.01
HADS-anxiety	6.5 (4.0)	6.2 (3.7)	4.4 (3.4)	< 0.01
HADS-depression—*n* (%)				< 0.01
Score ≥ 11	24 (10.7)	30 (4.6)	21 (1.5)	
BMI	28.4 (4.9)	28.7 (4.9)	28.7 (4.8)	0.69
BMI[a]—*n* (%)				0.91
Underweight (< 22 kg/m^2)	15 (5.5)	41 (5.2)	76 (4.5)	
Healthy weight (22–27 kg/m^2)	96 (35.2)	274 (34.6)	590 (34.8)	
Overweight (> 27 kg/m^2)	162 (59.3)	476 (60.2)	1029 (60.7)	
Smoking—*n* (%)	105 (34.2)	222 (25.8)	414 (22.2)	< 0.01
The number of comorbidities—*n* (%)				0.44
0–1	85 (27.7)	236 (27.4)	566 (30.3)	
2	111 (36.2)	311 (36.1)	677 (36.2)	
≥ 3	111 (36.2)	314 (36.5)	625 (33.5)	

NB All reported numbers are means and standard deviations (in parenthesis) except when otherwise stated,*SD* standard deviation, *PCI* percutaneous coronary intervention, *CABG* coronary artery bypass graft, *BMI* body mass index, *HADS* Hospital Anxiety and Depression Scale, *MI* myocardial infarction

[a]BMI classification was based on healthy weight range for people over age 65

($p < 0.01$), depression ($p < 0.01$), anxiety ($p < 0.01$), as well as smoking status ($p < 0.01$). Table 3 describes the adjusted effects of patients' demographic, clinical, and psycho-social characteristics on the differences among the identified trajectory subgroups for patients who survived over the follow-up. Specifically, results from the multinomial logistic regressions showed patients in the "Low" group were more likely to be women (OR = 1.67; 95% CI = [1.18, 2.36]), smokers (OR = 1.70; 95% CI = [1.23, 2.35]), and those endorsed more depression symptoms (OR = 8.10; 95% CI = [4.27, 15.36]) than those in the "High" trajectory subgroup. In addition, patients in the "Intermediate" group were also more likely to be women (OR = 1.51; 95% CI = [1.19, 1.91]) and endorse more depression symptoms (OR = 3.31; 95% CI = [1.76, 6.21]) than those in the "High" group.

Discussion

This study investigated the heterogeneity in longitudinal trajectories of perceived social support among patients with ACS who underwent cardiac catheterization and identified three distinct trajectories. Our findings revealed that the majority of patients reported moderate to high levels of stable perceived social support. However, about 10% of the cohort reported decreased social support over the 3-year period, majority of which are women who smoke, and endorse elevated levels of depression symptoms. Although we observed the stability of the changes of social support, which was in line with the previous studies [35], the theoretical perspectives of social support can be complex among older adults [35, 36], indicating dramatic events, such as, diagnosis of ACS or catheterization will either lead to decreases in support, lead to stability in pre- and post-event levels of support, or an increase in an attempt to compensate for the mental challenges [35, 36]. The knowledge of the variations in perceived levels of social support among individuals with ACS can help clinicians and health professionals design psycho-social interventions for this vulnerable group of patients.

Of interest are the findings that baseline risk factors including sex (being female), depression, anxiety, and smoking were most predictive of heterogeneity in MOS trajectories. These findings are consistent with previous evidence that revealed strong associations between social isolation and loneliness and smoking [37]. In particular, women are more likely to have low and declining levels of social support after catheterization than men. This finding is consistent with previous studies that reports gender disparity in perceived levels of social support [38, 39]. In addition, depression is significantly associated with lower social support in the present study; this is also in

Table 3 Associations (odds ratio, 95% CI) between patients' characteristics and MOS trajectory subgroup membership based on multiple imputation

Patients' characteristics	"Low" versus "High"	"Intermediate" versus "High"
Age	1.00 [0.98–1.01]	1.00 [0.99–1.02]
Sex (female vs. male)	1.67 [1.18–2.36]**	1.51 [1.19–1.91]***
Index treatment within a year of catheterization		
PCI versus no intervention received	0.81 [0.47–1.41]	0.97 [0.50–1.88]
CABG versus No intervention received	0.91 [0.65–1.27]	0.95 [0.55–1.21]
Left ventricular ejection fraction		
<50% versus > 50%	0.99 [0.70–1.39]	1.11 [0.88–1.40]
Not done versus > 50%	1.02 [0.53–1.97]	1.11 [0.70–1.76]
Indication for cardiac cath—*n* (%)		
Unstable angina or other versus MI	1.12 [0.77–1.63]	1.16 [0.92–1.46]
HADS-depression		
Score ≥ 11 versus score < 11	8.10 [4.27–15.36]***	3.31 [1.76–6.21]***
BMI		
Healthy weight versus underweight	1.07 [0.52–2.19]	1.07 [0.68–1.70]
Overweight versus underweight	1.03 [0.51–2.10]	1.05 [0.65–1.68]
Smoking	1.70 [1.23–2.35]**	1.26 [0.95–1.68]
The number of comorbidities		
2 versus 0–1	1.11 [0.74–1.65]	1.07 [0.82–1.38]
≥ 3 versus 0–1	1.23 [0.83–1.82]	1.25 [0.96–1.64]

"High" group is the reference group in the multinomial logistic regression

PCI percutaneous coronary intervention, *CABG* coronary artery bypass graft, *BMI* body mass index, *HADS* Hospital Anxiety and Depression Scale, *MI* myocardial infarction

**$p < 0.01$; ***$p < 0.001$

line with the evidence that patients who endorse fewer depressive symptoms are most likely to report higher social support [40]. This again demonstrates the interrelationship between social factors and psychological distress in cardiac patients [41]. These findings have important implications for front-line health professionals and policy makers with respect to the management of ACS, discharge planning, and allocation of healthcare resources. First, the knowledge about sex disparity in perceived social support among ACS can help front-line health professionals recognize sex-specific needs that can inform discussions and shared decisions about optimal clinical and behavioral interventions and recommendations that can improve patients' outcomes in the management of ACS. Second, these findings also highlight the need for additional social and mental health services, in addition to existing clinical services, for individuals with ACS after cath. Third, the identified trajectory subgroups and these risk factors can also inform discharge planning activities about appropriate post-discharge social and mental services for each ACS patients.

Strengths and limitations

Major strengths of this study include the application of group-based trajectory model (GBTM) to identify levels of social support and an adequate sample size for patients with ACS. GBTM has a number of advantages for analyzing longitudinal data. Unlike the conventional statistical models for longitudinal data (e.g., generalized estimating equations, and mixed-effects regression models) that estimate marginal changes in the development of changes over time, the group-based trajectory methodology is more flexible in characterizing heterogeneity in patients' longitudinal trajectories while describing risk factors that discriminate among these patient subgroups [28–31]. The different MOS trajectories appearing in our analyses show the multiple sources of heterogeneity in social support among ACS population.

This study is not without limitations. First, there is limited information on potential life stressors and patients' personalities, as these may need different types of social support and react to cardiac conditions differently [42]. Instead, we adjust for a patient-reported depression as a proxy for these real-life stressors and personalities. Second, our analyses were based on individuals with at least two repeated assessments. Although preliminary analyses of the data revealed a significant difference between individuals with only baseline assessment and those with at least two repeated measurements, patients with only baseline assessment were excluded considering the extrapolation of the longitudinal trajectories based on only one time point may be misleading. Given that this excluded group are more likely to be vulnerable than those included in our study, this might limit the external validity and generalization of our study findings to other cardiac population. In addition, our analyses did not adjust for patients' education, marital status, or socio-economic status, which may be important predictors of perceived social support in ACS patients [43], because data on these variables were only partially collected in the APPROACH registry.

Conclusions

In conclusion, this study identifies patterns of trajectories of social support in individuals with ACS. Although the majority of ACS patients showed increased or fairly stable trajectories of social support, about 10% of the cohort reported declining social support. These findings can inform targeted psychosocial interventions to improve their perceived social support and health outcomes.

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Compliance with ethical standards

Conflict of interest The authors declare that there's no conflict of interest.

Ethical approval Ethics approval was obtained from the University of Calgary Conjoint Health Research Ethics Board (REB14-1320).

Informed consent Informed consent was obtained from all subjects included in the study.

Appendix

See Tables 4, 5, 6 and 7 and Fig. 2.

Table 4 Comparisons of included and excluded patients' characteristics

Patients' characteristics	Excluded subjects $N=1983$	Included subjects $N=3036$	p-Value
Age	64.8 (11.9)	64.4 (10.8)	0.24
Male sex—*n* (%)	1532 (77.3)	2426 (79.9)	0.02
Affectionate support	79.8 (28.1)	82.9 (26.5)	< 0.01
Tangible (or instrumental) support	76.6 (28.0)	79.6 (26.7)	< 0.01
Positive social interaction	75.1 (27.3)	78.8 (25.8)	< 0.01
Emotional/informational support	68.9 (26.2)	72.8 (25.1)	< 0.01
Total social support	73.0 (23.4)	76.5 (22.8)	< 0.01
Treatment—*n* (%)			< 0.01
No intervention received	293 (14.8)	302 (10.0)	
PCI	1372 (69.2)	2261 (74.5)	
CABG	318 (16.0)	473 (15.6)	
Left ventricular ejection fraction—*n* (%)	987 (56.2)	1673 (61.9)	< 0.01
> 50	535 (30.5)	695 (25.7)	
< 50	233 (13.3)	335 (12.4)	
Not done			
Indication for cardiac cath—*n* (%)			0.40
MI	1508 (76.1)	2277 (75.0)	
Unstable or other	475 (24.0)	759 (25.0)	
HADS-depression	4.5 (3.5)	3.6 (3.1)	< 0.01
HADS-anxiety	6.0 (3.9)	5.1 (3.7)	< 0.01
Psychological assessment—*n* (%)			
HADS score ≥ 11	86 (5.9)	75 (3.3)	< 0.01
BMI	28.7 (5.2)	28.7 (4.8)	0.94
BMI[a]—*n* (%)			0.09
Underweight (< 22 kg/m^2)	112 (6.2)	132 (4.8)	
Healthy weight (22–27 kg/m^2)	646 (35.5)	960 (34.8)	
Overweight (> 27 kg/m^2)	1060 (58.3)	1667 (60.4)	
Smoking—*n* (%)	646 (32.6)	741 (24.4)	< 0.01
The number of comorbidities—*n* (%)			< 0.01
0–1	541 (27.3)	887 (29.2)	
2	614 (31.0)	1099 (36.2)	
≥ 3	828 (41.8)	1050 (34.6)	

The numbers presented are means and standard deviations except indicated otherwise

PCI percutaneous coronary intervention, *CABG* coronary artery bypass graft, *MED* medical treatment, *BMI* body mass index, *HADS* Hospital Anxiety and Depression Scale, *MI* myocardial infarction

[a]BMI classification was based on healthy weight range for people over 65

Table 5 Characteristics of study participants by MOS subgroup—based on original data without imputation

Patients' characteristics	"Low" $N=329$	"Intermediate" $N=930$	"High" $N=1777$	p Values
Age	63.7 (11.2)	64.5 (10.8)	64.5 (10.6)	0.45
Male sex—*n* (%)	247 (75.1)	696 (74.8)	1483 (83.5)	< 0.01
Affectionate support	39.8 (30.2)	73.5 (26.3)	95.5 (11.7)	< 0.01
Tangible (or instrumental) support	38.8 (28.4)	69.0 (26.3)	92.4 (13.8)	< 0.01
Positive social interaction	39.9 (26.4)	67.8 (23.6)	91.3 (15.1)	< 0.01
Emotional/informational support	33.7 (21.8)	60.9 (21.3)	86.0 (14.9)	< 0.01
Total social support	35.6 (18.2)	65.4 (17.9)	89.8 (10.7)	< 0.01
Index intervention within a year of cath—*n* (%)	35 (10.6)	101 (10.9)	163 (9.3)	0.76
No intervention received	242 (73.6)	688 (74.0)	1323 (75.1)	
PCI	52 (15.8)	141 (15.2)	276 (15.7)	
CABG				
Left ventricular ejection fraction—*n* (%)				0.47
> 50	182 (61.5)	499 (60.3)	992 (62.8)	
< 50	72 (24.3)	230 (27.8)	393 (24.9)	
Not done	42 (14.2)	98 (11.9)	195 (12.3)	
Indication for cardiac cath—*n* (%)				0.11
MI	249 (75.7)	719 (77.3)	1309 (73.7)	
Unstable angina or other	80 (24.3)	211 (22.7)	468 (26.3)	
HADS-depression	5.5 (3.7)	4.3 (3.2)	2.9 (2.6)	
HADS-anxiety	6.5 (4.0)	6.1 (3.7)	4.4 (3.4)	
Psychological assessment—*n* (%)				< 0.01
HADS score ≥ 11	23 (9.6)	31 (4.4)	21 (1.6)	
HADS-anxiety				
BMI	28.5 (4.9)	28.7 (4.9)	28.7 (4.8)	0.73
BMI[a]—*n* (%)				0.99
Underweight (< 22 kg/m^2)	15 (5.1)	40 (4.7)	77 (4.8)	
Healthy weight (22–27 kg/m^2)	101 (34.5)	294 (34.8)	565 (34.9)	
Overweight (> 27 kg/m^2)	177 (60.4)	512 (60.5)	978 (60.4)	
Smoking—*n* (%)	104 (31.6)	240 (25.8)	397 (22.3)	< 0.01
The number of comorbidities—*n* (%)				0.43
0–1	93 (28.3)	260 (28.0)	534 (30.1)	
2	120 (36.5)	327 (35.2)	652 (36.7)	
≥ 3	116 (35.3)	343 (36.9)	591 (33.3)	

The numbers presented are means and standard deviations except indicated otherwise

PCI percutaneous coronary intervention, *CABG* coronary artery bypass graft, *BMI* body mass index, *HADS* Hospital Anxiety and Depression Scale, *MI* myocardial infarction

[a]BMI classification was based on healthy weight range for people over 65

Table 6 Associations (odds ratio, 95% CI) between patients' characteristics and MOS trajectory subgroup membership for patients survived—based on original data without imputation

Patients' characteristics	"Low" versus "High"	"Intermediate" versus "High"
Age	1.00 [0.98–1.01]	1.00 [0.99–1.01]
Sex (female versus male)	1.47 [1.01–2.18]*	1.64 [1.26–2.13]***
Index treatment within a year of catheterization		
PCI versus no intervention received	0.67 [0.40–1.11]	0.82 [0.58–1.16]
CABG versus no intervention received	0.82 [0.45–1.51]	0.70 [0.45–1.08]
Left ventricular ejection fraction		
<50% versus > 50%	1.15 [0.79–1.68]	1.15 [0.89–1.47]
Not done versus > 50%	1.21 [0.75–1.94]	0.97 [0.70–1.35]
Indication for cardiac cath—n (%)		
Unstable angina or other versus MI	0.92 [0.62–1.37]	0.71 [0.54–0.94]*
Psychological assessment		
HADS score ≥ 11 versus HADS score < 11	5.80 [2.85–11.81]***	2.80 [1.47–5.33]**
BMI		
Healthy weight versus underweight	1.04 [0.48–2.27]	1.04 [0.62–1.74]
Overweight versus underweight	1.01 [0.45–2.17]	0.94 [0.57–1.56]
Smoking	1.44 [0.99–2.11]	1.20 [0.93–1.56]
The number of comorbidities		
2 versus 0–1	0.98 [0.65–1.45]	1.02 [0.78–1.33]
≥ 3 versus 0–1	1.07 [0.70–1.62]	1.25 [0.95–1.66]

PCI percutaneous coronary intervention, *CABG* coronary artery bypass graft, *BMI* body mass index, *HADS* Hospital Anxiety and Depression Scale, *MI* myocardial infarction

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 7 Bayesian information criterion (BIC) and Akaike information criterion (AIC) during model selection—group-based trajectory modeling

Imputed dataset #1				
The number of trajectories	1	2	3	4
The smallest group membership	1	23%	11%	4.9%
BIC	− 38,289	− 36,923	− 36,675	− 36,637
AIC	− 38,280	− 36,905	− 36,648	− 36,601
Imputed dataset #2				
The number of trajectories	1	2	3	4
The smallest group membership	1	24%	10%	6%
BIC	− 38,316	− 36,954	− 36,662	− 36,634
AIC	− 38,307	− 36,936	− 36,635	− 36,598
Imputed dataset #3				
The number of trajectories	1	2	3	4
The smallest group membership	1	23%	10%	5%
BIC	− 38,293	− 36,918	− 36,637	− 36,602
AIC	− 38,284	− 36,900	− 36,610	− 36,566
Imputed dataset #4				
The number of trajectories	1	2	3	4
The smallest group membership	1	24%	11%	4%
BIC	− 38,311	− 36,944	− 36,653	− 36,619
AIC	− 38,302	− 36,926	− 36,626	− 36,583
Imputed dataset #5				
The number of trajectories	1	2	3	4
The smallest group membership	1	24%	10%	5%
BIC	− 38,270	− 36,915	− 36,658	− 36,610
AIC	− 38,261	− 36,897	− 36,631	− 36,574

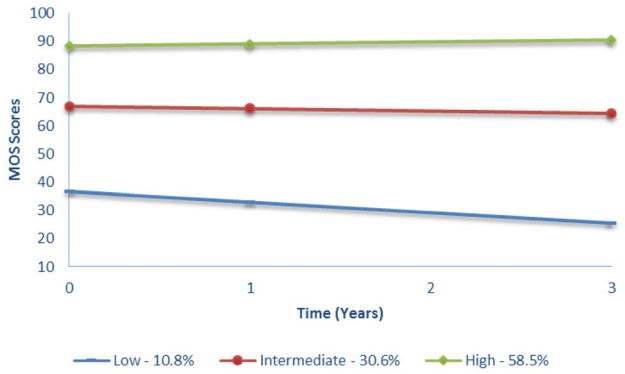

Fig. 2 Longitudinal social support trajectories based on MOS scores—based on original data without imputation

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