Available online at www.sciencedirect.com

Resuscitation Plus

journal homepage: www.elsevier.com/locate/resuscitation-plus

Clinical paper

Is insomnia associated with self-reported health and life satisfaction in cardiac arrest survivors? A cross-sectional survey

Patrik Hellström[a,*], *Johan Israelsson*[a,b], *Amanda Hellström*[a], *Carina Hjelm*[c], *Anders Broström*[d,e,f], *Kristofer Årestedt*[a,g]

Abstract

Background: Insomnia symptoms seem to be common in cardiac arrest survivors but their associations with important outcomes such as self-reported health and life satisfaction have not previously been reported during the early post-event period. Therefore, the aim of the study was to investigate whether symptoms of insomnia are associated with self-reported health and life satisfaction in cardiac arrest survivors six months after the event.

Methods: This multicentre cross-sectional survey included cardiac arrest survivors ≥18 years. Participants were recruited six months after the event from five hospitals in southern Sweden, and completed a questionnaire including the Minimal Insomnia Symptom Scale, EQ-5D-5L, Health Index, Hospital Anxiety and Depression Scale, and Satisfaction With Life Scale. Data were analysed using the Mann-Whitney U test, linear regression, and ordinal logistic regression. The regression analyses were adjusted for demographic and medical factors.

Results: In total, 212 survivors, 76.4% males, with a mean age of 66.6 years (SD = 11.9) were included, and of those, 20% reported clinical insomnia. Insomnia was significantly associated with all aspects of self-reported health ($p < 0.01$) and life satisfaction ($p < 0.001$), except mobility ($p = 0.093$), self-care ($p = 0.676$), and usual activities ($p = 0.073$).

Conclusion: Insomnia plays a potentially important role for both health and life satisfaction in cardiac arrest survivors. Screening for sleep problems should be part of post cardiac arrest care and follow-up to identify those in need of further medical examination and treatment.

Keywords: Health, Sleep, Quality of life, Life satisfaction, Psychological distress, Insomnia

Introduction

Sudden cardiac arrest is a significant health problem worldwide, and is associated with a high risk of mortality.[1] During the last decades, improvements in survival rates have been reported,[2] and more people are therefore in need of post-cardiac arrest care and follow-up. For many people, surviving a cardiac arrest has a significant impact on their life: they have to relate to a new self-image, cope with lowered capacity, and perhaps experience fear of having a new cardiac arrest.[3,4] Therefore, self-reported health and life satisfaction are important outcome measures for survivors.[5] Previous studies have shown that cardiac arrest survivors in general perceive their health as good, but large variations within and between studies are reported.[6,7] In particular, it is common for cognitive impairment, psychological problems, and fatigue to be reported.[8–10] Although these problems are generally known to be associated with insomnia,[11–13] little is known about insomnia in cardiac arrest survivors.

Insomnia is a common health problem in the general population, and may take the form of difficulty initiating sleep, waking up during the night, and light, poor, or non-restorative sleep. It covers a spectrum of complaints about quality, continuity, or duration of sleep.[14] Although stressful life events are recognised as risk factors for insomnia,[15] few studies have explored insomnia in cardiac arrest survivors. One qualitative study reported that nurses often observe sleep problems in survivors during their hospital stay, and these problems are perceived to linger also after discharge.[16] This is supported by a previous survey of survivors conducted by our research

* Corresponding author at: Faculty of Health and Life Sciences, Linnaeus University, 39182 Kalmar, Sweden.
E-mail address: patrik.hellstrom@lnu.se (P. Hellström).

https://doi.org/10.1016/j.resplu.2023.100455
Received 4 June 2023; Received in revised form 19 July 2023; Accepted 5 August 2023

group, in which about a fifth of the participants reported insomnia problems six months after the event.[17] However, few if any studies have investigated the association between insomnia symptoms, self-reported health, and life satisfaction in survivors during the early post-event period.

Aim

The aim of the study was to investigate whether symptoms of insomnia are associated with self-reported health and life satisfaction in cardiac arrest survivors six months after the event.

Methods

Study design

The present cross-sectional survey used data from a larger multicentre research project that aimed to explore health and quality of life over time in cardiac arrest survivors and their family members[17,18]; data was collected 6, 12, and 24 months after the cardiac arrest event between 2013 and 2020. In the present study, data from the first assessment was used. The study has been approved by the Regional Ethical Review Board in Linköping, Sweden (No. 2013/235-31).

Participants and procedure

The participants were consecutively recruited between 2013 and 2018 from two university hospitals and three county hospitals in the south of Sweden. Individuals who were 18 years or older, and survivors of a cardiac arrest due to cardiopulmonary disease, were eligible for inclusion. Difficulty understanding the study instructions or having an expected short duration of survival, for example end-stage cancer, were used as exclusion criteria. The survivors were identified during a follow-up procedure for the Swedish Register of Cardiopulmonary Resuscitation (https://shlr.registercentrum.se/) at the participating hospitals. The follow-up takes the form of a post-cardiac arrest telephone interview by a registry nurse. Invited survivors received information about the study, a consent form, and a questionnaire by mail six months after resuscitation. Survivors not replying received one reminder.

Measurements

Data regarding time and place of the cardiac arrest were obtained from the Swedish Register of Cardiopulmonary Resuscitation. The questionnaire included information about sex, age, cohabitation status, education, financial situation, health care utilization, post-cardiac arrest treatment (ICD and PCI treatment), self-reported comorbidity, and validated measures to assess insomnia, self-reported health, and life satisfaction.

Minimal insomnia symptom scale

The Minimal Insomnia Symptom Scale measures symptoms of insomnia and consists of three items, covering difficulty falling asleep, waking up in the night, and not feeling refreshed by sleep. The response options range between *'Not at all'* (0) to *'Extremely'* (4). The total score, calculated by adding the responses to the three items, has a possible range of 0 to 12. A higher score indicates more severe problems and a cut-off score of $\geq$ 6 is suggested for clinical insomnia.[19,20] The instrument has demonstrated satisfactory psychometric properties in a general and an elderly population.[19,21] For the present study, Cronbach's alpha was 0.76.

EuroQol 5 dimensions 5 levels (EQ-5D-5L)

The EQ-5D-5L measures health status and consists of five items that cover five health domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The response options range from '*No problems*' (1) to '*Extreme problems*' (5). The EQ-5D-5L also includes the EQ VAS, a visual analogue scale measuring overall self-reported health status. The EQ VAS has a possible range between 0 and 100 with endpoints labelled '*The worst health you can imagine*' (0) and '*The best health you can imagine*' (100).[22,23] The EQ-5D-5L has previously been used to assess health in cardiac arrest survivors[24] and is recommended as an core outcome measure.[5]

Health Index

The Health Index measures general health and consists of nine items: energy, temper, fatigue, loneliness, sleep, dizziness, bowel function, pain, and mobility. The response options range from '*Major problems*' (1) to '*No problems*' (4). The responses can be added into a total score ranging from 9 to 36. A higher score indicates better perceived general health.[25] The Health Index has shown satisfactory measurement properties[25,26] but has not been evaluated in cardiac arrest survivors. Cronbach's alpha for the present study was 0.80.

Hospital Anxiety and Depression Scale (HADS)

The HADS was developed to detect psychological distress in non-psychiatric patients. It consists of 14 items divided into two subscales, anxiety and depression.[27] The response options range from 0 to 3 and each subscale has a possible score ranging from 0 to 21; a higher score indicates higher levels of symptoms.[28] The HADS is recommended in international cardiac arrest guidelines.[29] In the present study, Cronbach's alpha was 0.89 for HADS anxiety and 0.87 for HADS depression.

Satisfaction With Life Scale

The Satisfaction With Life Scale measures life satisfaction[30] and consists of five items. The response options range between '*Completely correct*' (1) to '*Not correct at all*' (5). The item scores are added into a total score with a possible range from 5 to 25, with higher scores indicating higher levels of life satisfaction. The Satisfaction With Life Scale has demonstrated good measurement properties,[31] but has not been evaluated in cardiac arrest survivors. In the present study, Cronbach's alpha was 0.91.

Data analysis

The study variables were presented with descriptive statistics. Independent sample *t*-test, Pearson chi-square test, or Fishers' exact test were used to test for differences between participants with and without clinical insomnia measured by the Minimal Insomnia Symptom Scale cut-off scores.

Differences in self-reported health and life satisfaction between participants with and without clinical insomnia were tested using the Mann-Whitney U test. The eta-square was used to estimate the effect size, interpreted according to Cohen,[32] with 0.02 = small, 0.13 = medium, 0.26 = large.

To investigate if symptoms of insomnia were associated with self-reported health and life satisfaction, regression analyses were applied. For the continuous outcome variables (EQ VAS, Health Index, HADS, and Satisfaction With Life Scale), multiple linear

regression analyses were conducted. Insomnia was included as an explanatory variable, while age, sex, cohabitation status, economy, education, health care, ICD treatment, place of cardiac arrest, and revascularization were included as adjusting covariates. Decomposed R^2 values (Shapley value regression) were calculated to estimate the extent to which insomnia could explain the total variance in the outcome variables.[33] Since the residuals were not normally distributed, non-parametric percentile bootstrapped confidence intervals and *p*-values were calculated, based on 1000 replications. For the categorical outcome variables (EQ-5D-5L health dimensions and Health Index items), multiple ordinal logistic regression analyses were conducted with insomnia as an explanatory variable. These models were adjusted with the same covariates as used in the linear regression models.

Statistical significance was set at $p < 0.05$. The linear regression analyses were conducted in R 2.4.1 (R Foundation for Statistical Computing, Vienna, Austria) including the following packages: boot.pval 0.4 and relaimpo 2.2-6. All other statistical analyses were conducted in Stata 15.1 (StataCorp LP, College Station, TX, USA).

Results

Background characteristics

In total, 317 cardiac arrest survivors were identified during the register follow-up and invited to participate. Of these, 212 agreed to participate (67% response rate). If missing data were presented, the survivors were contacted by phone and asked for completion; all except one survivor with missing data was supplemented. No significant differences in respect of age or sex were detected between participants and non-participants. Of the included survivors, 136 (64%) had experienced in-hospital and 76 (36%) out-of-hospital cardiac arrest. The mean age was 66.6 years (SD = 11.9) and the majority were male (n = 162, 76%). Most of the survivors were cohabiting (n = 174, 82%), did not have a university degree (n = 159, 75%), and reported a good economic situation (n = 190, 90%). In total, 76 (36%) were treated with an ICD, and 139 (66%) underwent a PCI (Table 1).

Symptoms of insomnia

The survivors reported a median score of 3 (q1–q3 = 1–5) on Minimal Insomnia Symptom Scale and clinical insomnia was reported by 42 (20%) survivors. Self-reported comorbidity was significantly more common among survivors with clinical insomnia (57% vs. 38%, $p = 0.026$). In addition, survivors with clinical insomnia reported significantly more healthcare contacts (59% vs. 41%, $p = 0.035$) post-hospital discharge. No other differences were detected between the two groups (Table 1).

Insomnia and self-reported health

General health

Survivors with clinical insomnia reported significantly lower general health, measured with EQ VAS ($p = 0.002$, $\eta^2 = 0.215$) and Health Index total ($p < 0.001$, $\eta^2 = 0.153$), compared to those with no clinical insomnia (Table 2). These differences remained in the adjusted regression models. Independently of the adjusting covariates, symptoms of insomnia explained 10% of the total variance in EQ VAS and 29% in Health Index total according to the Shapely R^2 (Table 3).

Physical health

Problems with pain, strength, tiredness, sleep, dizziness, and digestion were all significantly more pronounced in survivors with clinical insomnia ($p = 0.008$, $\eta^2 = 0.034$ to $p < 0.001$, $\eta^2 = 0.281$). Problems with mobility were also more pronounced among those with clinical insomnia when measured with Health Index ($p = 0.045$, $\eta^2 = 0.019$) but not with EQ-5D-5L ($p = 0.274$, $\eta^2 = 0.006$) (Table 2). These differences remained in the adjusted regression models (Table 4). No significant differences were shown for self-care and usual activities (Tables 2 and 4).

Psychological health

Survivors with clinical insomnia reported significantly higher levels of anxiety ($p = 0.003$, $\eta^2 = 0.041$) and depression ($p < 0.001$, $\eta^2 = 0.064$), measured with the HADS, compared to survivors with no clinical insomnia. In addition, a significant difference was also shown for anxiety/depression measured with the EQ-5D-5L ($p = 0.001$, $\eta^2 = 0.057$) (Table 2). These differences remained in the adjusted regression models. Independently of the adjusting covariates, symptoms of insomnia explained 19% of the total variance in anxiety and 20% in depression according to the Shapely R^2 (Tables 3 and 4).

Insomnia and life satisfaction

Survivors with clinical insomnia reported significantly poorer life satisfaction compared to survivors with no clinical insomnia ($p < 0.001$, $\eta^2 = 0.070$) (Table 2). This difference remained in the adjusted regression model. Independently of the adjusting covariates, symptoms of insomnia explained 21% of the total variance in life satisfaction according to the Shapely R^2 (Table 3).

Discussion

To our best knowledge, this is the first study to investigate symptoms of insomnia in relation to self-reported health and life satisfaction in cardiac arrest survivors during the early post-event period. The results showed that insomnia was associated with lower levels of self-reported health and life satisfaction, also after adjustments of demographical and medical factors.

About a fifth of the survivors reported clinical insomnia. According to the European guidelines for the diagnosis and treatment of insomnia, the estimated prevalence in the general population is about 10%.[34] Insomnia is a disorder of hyperarousal, where the onset would be triggered by traumatic events such as cardiac arrest.[35] In most people, insomnia resolves spontaneously in the course of a few weeks, in parallel with other symptoms related to trauma and stress. However, some individuals develop residual stress-related symptoms.[36] The reason for the higher prevalence among survivors may be understood from the 3P model. According to this model, insomnia is captured by predisposing, precipitating, and perpetuating factors.[37] In this context, predisposing factors for insomnia in cardiac arrest may be related to previous illnesses, such as cardiovascular disease, while the cardiac event initiates the onset of insomnia and could therefore be seen as a precipitating factor. Finally, fear of an unknown future and another cardiac arrest[4] may be one of the possible perpetuating factors for insomnia. It has been suggested by Werner, Riemann, and Ehring[36] that fear of falling asleep may be a contributing factor in the maintenance of trauma-induced insomnia. Fear of falling asleep is an emotional experience of fear in relation to

Table 1 – Characteristics of the participants in relation to insomnia.

Variables	All, *n* = 212	No insomnia, *n* = 170	Insomnia, *n* = 42	*p*-value
Age, mean (SD) [min/max]	66.6 (11.9) [30–90]	67.0 (11.6) [30–90]	64.5 (12.8) [35–87]	0.212[a]
Sex, *n* (%)				0.209[b]
Male	162 (76.4)	133 (78.4)	29 (69.1)	
Female	50 (23.6)	37 (21.8)	13 (31.0)	
Cohabitation status, *n* (%)				0.832[b]
Living alone	38 (17.9)	30 (17.6)	8 (19.1)	
Cohabiting	174 (82.1)	140 (82.4)	34 (81.0)	
Education, *n* (%)				0.551[b]
Lower than University	159 (75.0)	126 (74.1)	33 (78.6)	
University	53 (25.0)	44 (25.9)	9 (21.4)	
Perceived economic situation, *n* (%)				0.386[c]
Good	190 (90.0)	154 (91.1)	36 (85.7)	
Poor	21 (10.0)	15 (8.9)	6 (14.3)	
Unknown	1	1	0	
Place of cardiac arrest				0.704[b]
In-hospital	136 (64.2)	108 (63.5)	28 (66.7)	
Out-of-hospital	76 (35.9)	62 (36.5)	14 (33.3)	
ICD, *n* (%)				0.753[b]
Yes	76 (35.9)	60 (35.3)	16 (38.1)	
No	136 (64.4)	110 (64.7)	26 (61.9)	
PCI/CABG, *n* (%)				0.867[b]
Yes	139 (65.6)	111 (65.3)	28 (66.7)	
No	73 (34.4)	59 (34.7)	14 (33.3)	
Self-reported co-morbidity, *n* (%)				0.026[b]
Yes	89 (42.0)	65 (38.2)	24 (57.1)	
No	123 (58.0)	105 (61.8)	18 (42.9)	
Healthcare contacts after the cardiac arrest, *n* (%)				0.035[c]
No	124 (58.5)	106 (62.4)	18 (42.9)	
1–2 times	61 (28.8)	47 (27.7)	14 (33.3)	
3–5 times	23 (10.8)	15 (8.8)	8 (19.1)	
>5 times	4 (1.9)	2 (1.2)	2 (4.8)	
Prescription drugs for anxiety/depression, *n* (%)				0.131[b]
Yes	30 (14.1)	21 (12.4)	9 (21.4)	
No	182 (85.9)	149 (87.7)	33 (78.6)	
Counseling, *n* (%)				0.780[b]
Yes	52 (24.5)	41 (24.1)	11 (26.2)	
No	160 (75.5)	129 (75.9)	31 (73.8)	

CABG = Coronary Artery Bypass Grafting, ICD = Implantable Cardioverter Defibrillator, PCI = Percutaneous Coronary Intervention.

[a] Independent sample *t*-test.

[b] Pearson chi-square test.

[c] Fisher exact test.

sleep, dysfunctional beliefs about safety during sleep, loss of control, and the experience of nightmares, as well as maladaptive behaviour related to fear (e.g. avoidance of sleep, keeping lights on).[36] In a study describing nurses' perceptions of survivors' sleep, many patients were perceived as afraid to fall asleep.[16]

Survivors with clinical insomnia scored lower levels of self-reported health compared to those without clinical insomnia. An association between insomnia and health has previously been shown in general populations[38–40] and in different health conditions, for example heart failure.[41] However, to our knowledge, this is the first study to investigate such an association in survivors. One interesting finding was that insomnia was more strongly associated with psychological than physiological aspects of health. This finding has also been shown in other groups, e.g. the general population, intensive care patients, individuals with mental disorders, and patients with cardiac diseases.[42–45] One possible explanation could be the traumatic, existential aspects of cardiac arrest, and the fear of potentially suffering another event. This is supported by previous research showing that traumatized people experience fear in relation to sleep, since sleep implies losing control of the situation and may also involve nightmares arising from the trauma.[36]

In the present study, survivors with clinical insomnia scored lower levels of life satisfaction compared with those without clinical insomnia. Overall, the association between insomnia and life satisfaction is less studied than insomnia and self-reported health, and no study was found that explored such associations in survivors. Our findings are therefore novel, particularly since insomnia explained about a third of the total variance in self-reported health, and a fifth in life satisfaction. Considering how common insomnia is in survivors, and its strong associations with self-reported health and life satisfaction, screening for insomnia should be part of post-cardiac arrest care. In 2022, the American Heart Association added sleep as a life-essential key measure for improving and maintaining cardiovascular health.[46] Despite this, there are no European guidelines for screen-

Table 2 – Self-reported health and life satisfaction in relation to insomnia among cardiac arrest survivors.

Variables, Mdn (q1, q3)	All *n* = 212	No insomnia[a] *n* = 170	Insomnia[a] *n* = 42	*p*-value[b]	η^{2c}
Self-reported health					
EQ-5D-5L					
Mobility	1 (1,2)	1 (1, 2)	1 (1, 2)	0.274	0.006
Self-care	1 (1, 1)	1 (1, 1)	1 (1, 1)	0.943	0.000
Usual activities	1 (1, 2)	1 (1, 2)	2 (1, 2)	0.050	0.018
Pain/Discomfort	2 (1, 2)	2 (1, 2)	2 (1, 3)	0.002	0.048
Anxiety/Depression	1 (1, 2)	1 (1, 2)	2 (1, 3)	0.001	0.057
EQ VAS	80 (70, 86)	80 (70, 88)	75 (60, 80)	0.002	0.215
Health Index					
Strength	3 (2, 3)	3 (3, 3)	3 (2, 3)	0.008	0.034
Mood	3 (3, 3)	3 (3, 4)	3 (2, 3)	< 0.001	0.071
Tiredness	3 (2, 3)	3 (2, 3)	2 (2, 3)	0.001	0.049
Loneliness	4 (3, 4)	4 (3, 4)	3 (3, 4)	< 0.001	0.062
Sleep	3 (3, 4)	3 (3, 4)	2 (2, 3)	< 0.001	0.281
Dizziness	3 (3, 4)	3 (3, 4)	3 (2, 3)	0.002	0.045
Digestion	4 (3, 4)	4 (3, 4)	3 (3, 4)	0.002	0.047
Pain	3 (3, 4)	3 (3, 4)	3 (2, 3)	< 0.001	0.073
Mobility	4 (3, 4)	4 (3, 4)	3 (3, 4)	0.045	0.019
Total scale	29 (26, 31)	30 (27, 32)	25 (22, 29)	< 0.001	0.153
HADS					
Anxiety	3 (0, 6)	2 (0, 5)	5 (1, 10)	0.003	0.041
Depression	1 (1, 4)	1 (1, 3)	4 (1, 8)	< 0.001	0.064
Life satisfaction					
Satisfaction With Life Scale	20 (19, 23)	20 (19, 23)	18 (14, 21)	< 0.001	0.070

HADS = Hospital Anxiety and Depression Scale.

[a] No insomnia = Minimal Insomnia Symptom Scale < 6, Insomnia = Minimal Insomnia Symptom Scale ≥ 6.

[b] Mann-Whitney U test.

[c] Eta-square effect size: 0.02 = small, 0.13 = medium, 0.26 = large.

Table 3 – Associations between insomnia (explanatory variable) and self-reported health and life satisfaction (outcome variables) based on multiple linear regression analyses with bootstrapped p-values and confidence intervals (n = 211).[a]

Scales (outcome variables)	B (se)[b]	CI 95% for b[c]	*p*-value[c]	Shapely R^{2d}	Model statistics[e]
EQ VAS	−1.82 (0.51)	−2.80, −0.82	< 0.001	0.10	F (12, 198) = 5.08, $p < 0.001$, $R^2 = 0.24$
Health Index	−0.78 (0.09)	−0.96, −0.60	< 0.001	0.29	F (12, 198) = 16.76, $p < 0.001$, $R^2 = 0.50$
HADS anxiety	0.68 (0.12)	0.45, 0.91	< 0.001	0.19	F (12, 197) = 6.70, $p < 0.001$, $R^2 = 0.29$
HADS depression	0.56 (0.10)	0.35, 0.76	< 0.001	0.20	F (12, 197) = 6.33, $p < 0.001$, $R^2 = 0.28$
Satisfaction With Life Scale	−0.72 (0.11)	−0.93, −0.51	< 0.001	0.21	F (12, 198) = 10.98, $p < 0.001$, $R^2 = 0.40$

HADS = Hospital Anxiety and Depression Scale.

[a] The multiple linear regression analyses are adjusted for age, sex, cohabitation status, education, economy, health care consumption, treatment with implantable cardioverter defibrillator, place of arrest, revascularization, and comorbidity.

[b] Unstandardized regression slope coefficients and corresponding standard errors.

[c] Percentile bootstrapped confidence intervals and *p*-values, based on 1000 replications.

[d] Shapley decomposed R^2 values reflect the relative importance of insomnia for self-reported health and life satisfaction in the multiple linear regression analyses.

[e] The R^2 reflect all explanatory variables in the multiple linear regression analyses.

ing or treating sleep problems in cardiac arrest survivors. From a clinical perspective, there is a desire for short and easy-to-use measures.[47] The Minimal Insomnia Symptom Scale meets these requirements as it is a simple and short screening measure for clinical insomnia, with good measurement properties in different samples.[20,21] However, the measurement properties have not been evaluated in survivors. Thus, Minimal Insomnia Symptom Scale needs to be validated for cardiac arrest before it can be recommended as a screening tool to detect insomnia in this group.

Methodological considerations

There are some limitations that need to be considered. No a priori power calculation was conducted but the sample size is considered sufficiently large according to general recommendations for linear regression models. For example, Green[48] recommends a minimum sample size of 117 observations to detect a medium effect size ($f^2 = 0.15$, $\alpha = 0.05$, and $1 - \beta = 0.8$). Since the number of out-of-hospital cardiac arrest survivors was below this minimum requirement, separate analyses for in-hospital and out-of-hospital cardiac

Table 4 – Associations between insomnia (explanatory variable) and self-reported health (outcome variables) based on multiple ordinal logistic regression analyses (n = 211).[a]

Scales	Outcome variables	OR	CI 95% for OR	*p*-value	Model statistics
EQ-5D-5L	Mobility	1.12	0.98, 1.29	0.093	χ^2 (12) = 56.75, $p < 0.001$, McFadden $R^2 = 0.15$
	Self-care	1.04	0.85, 1.28	0.676	χ^2 (12) = 22.88, $p = 0.029$, McFadden $R^2 = 0.14$
	Usual activities	1.12	0.99, 1.26	0.073	χ^2 (12) = 41.68, $p < 0.001$, McFadden $R^2 = 0.10$
	Pain/Discomfort	1.27	1.12, 1.43	< 0.001	χ^2 (12) = 52.63, $p < 0.001$, McFadden $R^2 = 0.11$
	Anxiety/Depression	1.33	1.17, 1.52	< 0.001	χ^2 (12) = 50.81, $p < 0.001$, McFadden $R^2 = 0.13$
Health Index	Strength	0.83	0.72, 0.94	0.003	χ^2 (12) = 54.70, $p < 0.001$, McFadden $R^2 = 0.14$
	Mood	0.70	0.60, 0.81	< 0.001	χ^2 (12) = 50.11, $p < 0.001$, McFadden $R^2 = 0.14$
	Tiredness	0.74	0.65, 0.84	< 0.001	χ^2 (12) = 61.23, $p < 0.001$, McFadden $R^2 = 0.13$
	Loneliness	0.70	0.62, 0.81	< 0.001	χ^2 (12) = 68.14, $p < 0.001$, McFadden $R^2 = 0.17$
	Sleep	0.40	0.33, 0.49	< 0.001	χ^2 (12) = 169.31, $p < 0.001$, McFadden $R^2 = 0.36$
	Dizziness	0.79	0.70, 0.89	< 0.001	χ^2 (12) = 38.54, $p < 0.001$, McFadden $R^2 = 0.09$
	Digestion	0.79	0.69, 0.89	< 0.001	χ^2 (12) = 50.97, $p < 0.001$, McFadden $R^2 = 0.13$
	Pain	0.80	0.71, 0.90	< 0.001	χ^2 (12) = 52.82, $p < 0.001$, McFadden $R^2 = 0.11$
	Mobility	0.82	0.72, 0.94	0.003	χ^2 (12) = 70.70, $p < 0.001$, McFadden $R^2 = 0.18$

[a] The ordinal logistic regression analyses are adjusted for age, sex, cohabitation status, education, economy, health care consumption, treatment with implantable cardioverter defibrillator, place of arrest, revascularization, and comorbidity.

arrest could not be performed. As the experience of surviving a cardiac arrest likely are different for in-hospital and out-of-hospital cardiac arrest, this should be addressed in future studies. One major limitation is the cross-sectional design of the study; since data are collected at a single point in time, no conclusions can be drawn about the causality of the relationships. Therefore, future prospective studies are needed. As participants were identified from the Swedish Register of Cardiopulmonary Resuscitation, we had no information about non-responders and therefore, no drop out analysis could be performed. In addition, the design of the study implies a selection bias since the data collection required that the patients themselves should complete the questionnaire. Thus, the most vulnerable survivors, i.e., those with a complicated cardiac arrest course and poor outcomes, such as severe cognitive decline, did not participate. Therefore, the findings should not be generalized to the most vulnerable survivors. As cognitive impairments are common in this group, this limitation is not unique to the present study. To handle this, other methods, such as proxy ratings or qualitative studies, are needed. Moreover, all instruments in the present study have been psychometrically evaluated, but not specifically for cardiac arrest survivors. Another limitation is that no information about prescribed hypnotics/sedatives were collected; future studies should include this information. Finally, since the Health Index contains items about tiredness and sleep, which may overestimate the associations with Minimal Insomnia Symptom Scale, an additional model excluding the items sleep and tiredness from Health Index was conducted. This sensitivity analysis confirmed the main analysis and supported our conclusions.

Conclusions

The results showed that insomnia was associated with all aspects of self-reported health and life satisfaction evaluated in the present study, except for mobility, self-care, and usual activities. Screening for sleep problems should be part of post cardiac arrest care and follow-up to identify those in need of further medical examination and treatment. The Minimal Insomnia Symptom Scale was easy to use in the population, but it is yet to be psychometrically tested and validated.

Funding

This work was supported by the Swedish Heart and Lung Association and the Medical Research Council of Southeast Sweden.

CRediT authorship contribution statement

Patrik Hellström: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing. **Johan Israelsson:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Supervision, Writing – review & editing. **Amanda Hellström:** Conceptualization, Methodology, Formal analysis, Writing – review & editing. **Carina Hjelm:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Anders Broström:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Kristofer Årestedt:** Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We would like to thank Elisabeth Ericsson, Emilie Bertilsson, Gunilla Edholm, Katarina Bång, Lillemor Håkansson, Maria Pettersson, and Monica Jonsson for their help with the data collection. A special thanks to the participating survivors.

Author details

[a]Faculty of Health and Life Sciences, Linnaeus University, Kalmar, Sweden [b]Department of Internal Medicine, Division of Cardiology, Kalmar County Hospital, Region Kalmar County, Kalmar, Sweden [c]Department of Health, Medicine and Care, Nursing and Reproductive Health, Linköping University, Linköping, Sweden[d]Department of Clinical Neurophysiology, Linköping University Hospital, Linköping, Sweden[e]Department of Nursing Science, School of Health and Welfare, Jönköping University, Jönköping, Sweden [f]Department of Health and Caring Sciences, Western Norway University of Applied Sciences, Bergen, Norway [g]The Research Section, Region Kalmar County, Kalmar, Sweden

REFERENCES

1. Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: Systematic review of 67 prospective studies. Resuscitation 2010;81:1479–87.
2. Rawshani A, Herlitz J. Det svenska HLR-registrets årsrapport 2020. Det svenska Hjärt-Lungräddningsregistret; 2021.
3. Bremer A, Dahne T, Stureson L, Arestedt K, Thylen I. Lived experiences of surviving in-hospital cardiac arrest. Scand J Caring Sci 2019;33:156–64.
4. Haydon G, van der Riet P, Inder K. A systematic review and meta-synthesis of the qualitative literature exploring the experiences and quality of life of survivors of a cardiac arrest. Eur J Cardiovasc Nurs 2017;16:475–83.
5. Haywood K, Whitehead L, Nadkarni VM, et al. COSCA (Core Outcome Set for Cardiac Arrest) in adults: an advisory statement from the International Liaison Committee on Resuscitation. Resuscitation 2018;127:147–63.
6. Djarv T, Bremer A, Herlitz J, et al. Health-related quality of life after surviving an out-of-hospital compared to an in-hospital cardiac arrest: a Swedish population-based registry study. Resuscitation 2020;151:77–84.
7. Elliott VJ, Rodgers DL, Brett SJ. Systematic review of quality of life and other patient-centred outcomes after cardiac arrest survival. Resuscitation 2011;82:247–56.
8. Wagner MK, Christensen AV, Hassager C, et al. Sex differences in patient-reported outcomes in the immediate recovery period after resuscitation: findings from the cross-sectional DenHeart survey. J Cardiovasc Nurs 2023;38:279–87.
9. Cronberg T, Greer DM, Lilja G, Moulaert V, Swindell P, Rossetti AO. Brain injury after cardiac arrest: from prognostication of comatose patients to rehabilitation. Lancet Neurol 2020;19:611–22.
10. Zook N, Voss S, Blennow Nordstrom E, et al. Neurocognitive function following out-of-hospital cardiac arrest: a systematic review. Resuscitation 2022;170:238–46.
11. Abe Y. Fatigue as a core symptom of insomnia. Innov Clin Neurosci 2012;9:10–1.
12. Hamdy RC, Kinser A, Dickerson K, et al. Insomnia and mild cognitive impairment. Gerontol Geriatr Med 2018;4 2333721418778421.
13. Riemann D, Krone LB, Wulff K, Nissen C. Sleep, insomnia, and depression. Neuropsychopharmacology 2020;45:74–89.
14. Morin C.M. and Espie CA. Insomnia. A clinical guide to assessment and treatment. New York: Springer-Verlag; 2013. p. 190.
15. Morin CM. Why do some people develop insomnia in response to stressful life events and others do not? Sleep 2022;45.
16. Hellstrom A, Bremer A, Gunnarsson LL, Hjelm C. Sleep in cardiac arrest survivors. Nurs Crit Care 2022.
17. Hellstrom P, Arestedt K, Israelsson J. A comprehensive description of self-reported health and life satisfaction in cardiac arrest survivors. Scand J Trauma Resusc Emerg Med 2021;29:122.
18. Israelsson J, Persson C, Bremer A, Stromberg A, Arestedt K. Dyadic effects of type D personality and perceived control on health-related quality of life in cardiac arrest survivors and their spouses using the actor-partner interdependence model. Eur J Cardiovasc Nurs 2020;19:351–8.
19. Broman JE, Smedje H, Mallon L, Hetta J. The Minimal Insomnia Symptom Scale (MISS): a brief measure of sleeping difficulties. Ups J Med Sci 2008;113:131–42.
20. Westergren A, Broman JE, Hellstrom A, Fagerstrom C, Willman A, Hagell P. Measurement properties of the minimal insomnia symptom scale as an insomnia screening tool for adults and the elderly. Sleep Med 2015;16:379–84.
21. Hellstrom A, Hagell P, Fagerstrom C, Willman A. Measurement properties of the Minimal Insomnia Symptom Scale (MISS) in an elderly population in Sweden. BMC Geriatr 2010;10:84.
22. Herdman M, Gudex C, Lloyd A, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). Qual Life Res 2011;20:1727–36.
23. EuroQol G. EuroQol–a new facility for the measurement of health-related quality of life. Health Policy 1990;16:199–208.
24. Israelsson J, Bremer A, Herlitz J, et al. Health status and psychological distress among in-hospital cardiac arrest survivors in relation to gender. Resuscitation 2017;114:27–33.
25. Forsberg C, Bjorvell H. Swedish population norms for the GHRI, HI and STAI-state. Qual Life Res 1993;2:349–56.
26. Sjostrom H, Langius-Eklof A, Hjertberg R. Well-being and sense of coherence during pregnancy. Acta Obstet Gynecol Scand 2004;83:1112–8.
27. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983;67:361–70.
28. Snaith RP. The hospital anxiety and depression scale. Health Qual Life Outcomes 2003;1:29.
29. Nolan JP, Soar J, Cariou A, Cronberg T, Moulaert VR, Deakin CD, et al. European Resuscitation Council and European Society of Intensive Care Medicine guidelines for post-resuscitation care 2015: section 5 of the European Resuscitation Council guidelines for resuscitation 2015. Resuscitation 2015;95:202–22.
30. Diener E, Emmons RA, Larsen RJ, Griffin S. The Satisfaction With Life Scale. J Pers Assess 1985;49:71–5.
31. Hinz A, Conrad I, Schroeter ML, et al. Psychometric properties of the Satisfaction with Life Scale (SWLS), derived from a large German community sample. Qual Life Res 2018;27:1661–70.
32. Cohen. Statistical power analysis for the behavioral-sciences – Cohen. J Percept Motor Skill 1988;67:1007.
33. Gromping U. Relative importance for linear regression in R: the package relaimpo. J Stat Softw 2006;17.
34. Riemann D, Baglioni C, Bassetti C, et al. European guideline for the diagnosis and treatment of insomnia. J Sleep Res 2017;26:675–700.
35. Baglioni C, Riemann D. Is chronic insomnia a precursor to major depression? Epidemiological and biological findings. Curr Psychiatry Rep 2012;14:511–8.
36. Werner GG, Riemann D, Ehring T. Fear of sleep and trauma-induced insomnia: a review and conceptual model. Sleep Med Rev 2021;55 101383.
37. Perlis ML, Giles DE, Mendelson WB, Bootzin RR, Wyatt JK. Psychophysiological insomnia: the behavioural model and a neurocognitive perspective. J Sleep Res 1997;6:179–88.
38. Kyle SD, Morgan K, Espie CA. Insomnia and health-related quality of life. Sleep Med Rev 2010;14:69–82.
39. Hetta J, Broman JE, Mallon L. Evaluation of severe insomnia in the general population–implications for the management of insomnia: insomnia, quality of life and healthcare consumption in Sweden. J Psychopharmacol 1999;13:S35–6.

40. Ohayon MM, Hong SC. Prevalence of insomnia and associated factors in South Korea. J Psychosom Res 2002;53:593–600.
41. Gharzeddine R, McCarthy MM, Yu G, Dickson VV. Insomnia and insomnia symptoms in persons with heart failure: an integrative review. J Cardiovasc Nurs 2021;36:374–84.
42. Al Mutair A, Shamsan A, Salih S, Al-Omari A. Sleep deprivation etiologies among patients in the intensive care unit: literature review. Dimens Crit Care Nurs 2020;39:203–10.
43. Hoffmann G. Evaluation of severe insomnia in the general population–implications for the management of insomnia: focus on results from Belgium. J Psychopharmacol 1999;13:S31–2.
44. Tighe CA, Buysse DJ, Weiner DK, Beehler GP, Forman DE. Prevalence, impact, and trajectories of sleep disturbance in cardiac rehabilitation: a narrative review and suggestions for evaluation and treatment. J Cardiopulm Rehabil Prev 2022;42:316–23.
45. Hertenstein E, Johann A, Baglioni C, Spiegelhalder K, Riemann D. Treatment of insomnia – a preventive strategy for cardiovascular and mental disorders. Ment Health Prevent 2016;4:96–103.
46. Association AH. Life's Essential 8™: America Heart Association; 2023 [Available from: https://www.heart.org/en/healthy-living/healthy-lifestyle/lifes-essential-8].
47. Litchfield I, Greenfield S, Turner GM, Finnikin S, Calvert MJ. Implementing PROMs in routine clinical care: a qualitative exploration of GP perspectives. BJGP Open 2021;5.
48. Green SB. How many subjects does it take to do a regression analysis. Multivariate Behav Res 1991;26:499–510.