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Stressful life events and heart disease and stroke: A study among Portuguese older adults

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Abstract

The link between stressful life events (SLE) and cardiovascular diseases (CVD) remains underexplored. This study aimed to examine the association between SLE and the diagnosis of heart disease or stroke, among older adults. Data from 678 participants from the population-based cohort EPIPorto, with ≥60 years and complete information regarding SLE and heart disease or stroke, were analysed. Stressful life events were measured through the 'Stressful Life Events Screening Questionnaire'. A previous diagnosis of heart disease or stroke was self-reported. Adjusted odds ratios (OR) with the respective 95% confidence intervals were computed through logistic regression. Almost a fourth of the participants never experienced any SLE throughout life, 30.0% experienced at least one event, 17.5% experienced two and 27.7% had experienced three or more SLE. A dose-effect association between SLE and the diagnosis of heart disease or stroke was observed, statistically significant for those who had at least 3 types of SLE, independently of confounders (≥3SLE vs. 0SLE: OR = 2.00; 95% CI: 1.12–3.57). This cross-sectional study suggests that cumulative exposure to different types of SLE during the life course was associated with a higher likelihood of having a diagnosis of heart disease or a stroke at a later age. Future longitudinal studies should better deepen this association, particularly by evaluating which type of SLE is more related to a higher prevalence of heart disease and stroke, and how the timing of the SLE influence this relation.

KEYWORDS
ageing, heart disease, stressful life events, stroke

1 | INTRODUCTION

Cardiovascular disease (CVD) remains the leading cause of mortality worldwide, being responsible for 31% of all global deaths (Kandasamy & Anand, 2018). Specifically, 85% of these deaths were due to coronary heart disease or stroke (Nascimento et al., 2018; WHO, 2017). In Portugal, diseases of the circulatory system accounted for 29.9% of deaths in 2019; of these 9.8% were due to cerebrovascular disease, 6.4% to ischaemic heart disease, and 3.8% to acute myocardial infarction (Instituto Nacional de Estatística, 2021).

Hypertension, diabetes and unhealthy lifestyles are well-established risk factors for CVD (Duval et al., 2020). However, some determinants of CVD remain underexplored and a percentage of the aetiology of these diseases remains unexplained (Kreatsoulas et al., 2019; Yang et al., 2021). This gap might be partially justified by psychosocial determinants that are more difficult to measure, prevent and control. Cardiovascular risk accumulates throughout the life course and the social circumstances people live in, namely their adverse life experiences, play an important role in its development (Kreatsoulas et al., 2019). According to the literature and except for entrance ones, all categories of events, namely life events, were more

frequently reported by patients with acute coronary heart disease when compared to controls (Rafanelli et al., 2005).

The relationship between CVD and less explored social vulnerability factors, such as stressful life events (SLE) is still uncertain and worth to be deepened. Although SLE are complex to define, researchers have reached an understanding that severe circumstances, consensually seen as harmful or threatening to one's social status, self-esteem, identity, or physical well-being—such as the death of a spouse, sexual assault, or learning of a diagnosis of imminent death—are acute occasions expected to result in psychological and physiological stress responses for the individual (Cohen et al., 2019). It is expected that SLE are embedded throughout the life course leading to physiological alterations that can negatively influence health (Saadati et al., 2021; Yang et al., 2021). Heart diseases and stroke development are both conditions that affect disproportionally older people in Portugal.

This paper aims to examine the association between SLE and heart disease or stroke, in a population of adults aged 60 years or more, considering the cumulative effects of experiencing different types of SLE throughout the life course.

2 | MATERIALS AND METHODS

2.1 | Study design and participants

The present work analyses data collected between January and July of 2017 from participants of the EPIPorto cohort study (Dias et al., 2022), a population-based cohort of noninstitutionalised adults (>18–92 years) living in Porto, Portugal, established in 1999–2003 (Ramos et al., 2004).

At the beginning of this study, 1222 individuals from the cohort met the age criteria (60 years or older) and were invited to participate. Of the eligible participants, 281 could not be reached, 244 refused to participate in the study, and 697 individuals were evaluated. After excluding the participants with significant cognitive impairment (Mini-Mental State Examination score <24) (Folstein et al., 1975) ($n = 19$), the final sample of the current study comprised 678 participants with complete information regarding SLE and heart disease or stroke. Trained interviewers, using structured questionnaires, conducted personal interviews to collect self-reported data on sociodemographics, medical history, health behaviours, and psychological characteristics. Participants with mobility limitations were interviewed in their homes ($n = 71$).

2.2 | Data collection and variables definition

2.2.1 | Stressful life events

Stressful life events were analysed using 12 questions retrieved from the 'Stressful Life Events Screening Questionnaire' (SLESQ), a 13-item self-report screening measure designed to assess lifetime exposure to a variety of traumatic events in face-to-face interviews (Goodman et al., 1998). It is considered an empirically supported and evidence-based instrument for investigating the prevalence and impact of SLE and enables the study of life events in childhood, adolescence and adulthood (Butjosa et al., 2017).

Participants were asked to report if, at any moment since childhood, they ever had experienced one or more SLE from a specific list of events (see Table S1 in the supplementary file), with the answer options being dichotomous ("yes" or "no"). In the questionnaire used in the study, one of the original questions was removed due to its over-invasive nature (item 6 from the original SLESQ). Participants' responses to all events were summed, resulting in a variable that can range from 0 to 12, with higher scores corresponding to higher SLE exposure over the life course. Then, according to the variable distribution, a categorical variable was computed into no events, one SLE (i.e., exposed to one type of SLE), two types of SLE, and three or more types of SLE.

2.2.2 | Heart disease and stroke

A composite variable was developed to assess a previous diagnosis of heart disease or stroke, based on the responses to the questions: 'Currently, do you have cardiac problems (including angina pectoris, acute myocardial infarction, heart failure)?', and 'Did you have thrombosis or stroke?'. The possible answers were: 'yes' or 'no'. A previous diagnosis of heart disease or stroke was considered present when participants answered positively to at least one of these questions.

2.2.3 | Covariates

Covariates were selected a priori considering the literature and the principles of confounder selection (Van derWeele, 2019). Therefore, we controlled for each covariate that is a cause of exposure or outcome or both, namely: age, education, living alone, social support, self-rated health, depression, hypertension, alcohol consumption, physical exercise and smoking. A detailed description of the variables mentioned can be found in the supplementary file (see Supplementary note 1 in the supplementary file S1).

2.3 | Statistical analysis

Sample characteristics are presented as counts and proportions and the relationship between SLE exposure and the presence of heart disease or stroke was initially compared using the χ^2 test considering a significance level of 0.05.

Unconditional logistic regression models were fitted and adjusted odds ratios (OR) with the respective 95% confidence intervals (95% CI) were computed for the association between SLE and a diagnosis of heart disease or stroke. Separate models were built

from a list of a priori potential determinants to disentangle the effect of sociodemographic factors (Model 1: gender and age); social factors (Model 2: Model 1 + education + living alone + social support); psychological factors (Model 3: Model 2 + depression + self-rated health) and classic risk factors (Model 4: Model 3 + hypertension + alcohol consumption + smoking + physical exercise).

Statistical analyses were conducted using Stata, version 15.0 (College Station, TX, 2017).

3 | RESULTS

Among participants ≥80 years of age, 35.4% had one type of SLE and 17.3% had three or more types. The majority of the respondents who did not report any SLE had an education level between high school to uncompleted secondary education (28.7%), and the highest number of types of SLE was registered within the group with an education level below elementary school (32.7%). Among female participants, almost a third reported having one type of SLE and a quarter reported ≥3 types of SLE. Having ≥3 types of SLE was more prevalent in males (32.4%), those with elementary education (32.7%), those who did not live alone (29.8%), those who rated their health as low/very low (46.7%), those who did not practice physical exercise (29.1%), those who consumed alcohol daily (32.1%) and were current smokers (38.2%). The prevalence of heart disease or stroke was 24.3%. The prevalence of heart disease or stroke was 36.3% in those who experienced at least 3 types of SLE as opposed to 18.8% observed in those who never experienced SLE (Table 1).

The types of SLE more often reported were having experienced a very serious illness in their life (29.2%), the death of a close family member, partner or very close friend due to an accident, homicide or suicide (28.3%), and having already been attacked, injured or hit as a child by their parents, childminder or another person (22%). It was estimated that less than 5% of participants had been physically forced into engaging in sexual activity of any kind, and approximately 8% reported having been threatened with a weapon during a robbery or assault, or suffered from physical violence from a weapon (Figure 1).

During their life course, 24.7% of participants never experienced SLE, 30.0% experienced one type of event, 17.5% experienced two types of SLE, and 13.9% had three. In addition, 13.8% had between four and nine types of SLE.

There is a tendency that as the number of SLE types present increases, so does the risk of having heart disease or stroke, although only the latter category reaches statistical significance. In Model 1, which considers gender and age as covariates, higher SLE exposure was associated with a higher likelihood of heart disease or stroke compared to those who had never reported any SLE (≥3 SLE: OR = 2.32; 95% CI: 1.39–3.86). When education, living alone and social support were added, forming Model 2, the association remained positive (≥3SLE: OR = 2.36; 95% CI: 1.39–4.01). The same happened in Model 3 when depression and self-rated health were added (≥3SLE: OR = 2.11; 95% CI: 1.21–3.67). Finally, in the last Model 4, the association between at least 3 SLE and heart disease or stroke remained significant independently of gender, age, education level, living alone, social support, depression, self-rated health, hypertension, alcohol consumption, smoking and physical exercise (≥3SLE: OR = 2.00; 95%CI: 1.12–3.57) (Table 2).

4 | DISCUSSION

This cross-sectional study shows that almost a quarter of Portuguese men and women aged 60 years and over had a heart disease or stroke. Moreover, cumulative exposure to different types of SLE during the life course is associated with a higher likelihood of these diseases. This association is stronger when participants have experienced at least 3 different types of SLE, and is independent of the participants' sociodemographic, social, psychological and behavioural characteristics.

There is a progressive increase in the literature on the relationship between SLE and health, particularly CVD, which is reflected in a better understanding of the role of these stressors in disease risk (Cohen et al., 2019), however, the results so far reveal some inconsistencies. Two articles suggest that SLE are linked to both coronary heart disease and stroke (Kershaw et al., 2014), while another study considered exposure to adverse experiences during childhood and the expected accumulation of risk throughout the life course as a robust risk factor for CVD during adulthood (Kreatsoulas et al., 2019). However, a 7-year follow-up study concluded that major life events are associated with a moderately increased risk of stroke, but no association with risk of myocardial infarction was found (Kornerup et al., 2010). Although our results seem to confirm an association between SLE and heart disease and stroke, the dynamics linking SLE and cardiac events are complex and require a better understanding; namely given the variability in the definition of SLE as SLE progresses throughout life occurred (e.g. childhood or adulthood), the diversity of cardiovascular outcomes considered, and different and more accurate measurement methods.

CVD has often been assessed as the incidence of specific events such as coronary heart disease or myocardial infarction (Kershaw et al., 2014, 2015; Wang et al., 2021) or by very specific physiologic measures, such as heart rate variability (Vaessen et al., 2021). This study tries to counteract this tendency by covering the most important cardiovascular disorders more comprehensively, as it includes all heart disease and strokes known to the patient.

Regarding the definition of SLE, the literature acknowledges the difficulty of defining these events, which is reflected in the variety of scales used to measure SLE, as well as the different periods of vulnerability. The majority of studies investigate the occurrence of SLE at short intervals before the onset of the cardiovascular event to overcome recall bias (Berntson et al., 2017; Kershaw et al., 2014;

TABLE 1 Sociodemographic and health-related characteristics of the participants, according to the number of types of stressful life events (n = 678).

	n (%)				
	Stressful life events				
	Overall	0	1	2	≥3
Gender					
Female	428 (63.0)	115 (26.9)	131 (30.6)	75 (17.5)	107 (25.0)
Male	250 (37.0)	52 (20.8)	72 (28.8)	45 (18.0)	81 (32.4)
Age (years)					
60–69	306 (45.1)	80 (26.1)	83 (27.1)	52 (17.0)	91 (29.8)
70–79	245 (36.1)	53 (21.6)	75 (30.6)	42 (17.2)	75 (30.6)
≥80	127 (18.8)	34 (26.8)	45 (35.4)	26 (20.5)	22 (17.3)
Education[a]					
≤Elementary	248 (36.6)	50 (20.2)	72 (29.0)	45 (18.1)	81 (32.7)
≥High school to <Secondary	157 (23.1)	45 (28.7)	48 (30.6)	27 (17.2)	37 (23.5)
≥Secondary	273 (40.3)	71 (26.1)	83 (30.5)	48 (17.7)	70 (25.7)
Living alone					
No	524 (77.4)	127 (24.2)	153 (29.2)	88 (16.8)	156 (29.8)
Yes	153 (22.6)	40 (26.1)	50 (32.7)	31 (20.3)	32 (20.9)
Social support					
1 (low)	232 (34.6)	51 (21.9)	79 (34.1)	39 (16.8)	63 (27.2)
2	238 (35.4)	64 (26.9)	61 (25.6)	43 (18.1)	70 (29.4)
3 (high)	201 (30.0)	48 (23.9)	61 (30.3)	38 (18.9)	54 (26.9)
Self-rated health					
Good/Very good	309 (45.6)	80 (25.9)	95 (30.7)	57 (18.5)	77 (24.9)
Reasonable	324 (47.8)	79 (24.4)	101 (31.1)	54 (16.7)	90 (27.8)
Low/Very low	45 (6.6)	8 (17.8)	7 (15.5)	9 (20.0)	21 (46.7)
Depression[b]					
No	473 (72.7)	125 (26.4)	141 (29.8)	84 (17.8)	123 (26.0)
Yes	178 (27.3)	37 (20.8)	52 (29.2)	29 (16.3)	60 (33.7)
Hypertension[c]					
No	228 (35.1)	68 (29.8)	65 (28.5)	40 (17.6)	55 (24.1)
Yes	422 (64.9)	90 (21.3)	128 (30.3)	77 (18.3)	127 (30.1)
Alcohol consumption					
Never	146 (21.5)	29 (19.9)	52 (35.6)	28 (19.2)	37 (25.3)
Less than once a week	118 (17.4)	33 (28.0)	30 (25.4)	26 (22.0)	29 (24.6)
Weekly	152 (22.4)	45 (29.6)	42 (27.6)	27 (17.8)	38 (25.0)
Daily	262 (38.7)	60 (22.9)	79 (30.1)	39 (14.9)	84 (32.1)
Physical exercise					
None	234 (34.5)	49 (20.9)	77 (32.9)	40 (17.1)	68 (29.1)
Any	444 (65.5)	118 (26.6)	126 (28.4)	80 (18.0)	120 (27.0)

TABLE 1 (Continued)

	n (%)				
	Stressful life events				
	Overall	0	1	2	≥3
Smoking					
Never	399 (58.9)	114 (28.6)	120 (30.1)	71 (17.8)	94 (23.5)
Current	55 (8.1)	13 (23.6)	14 (25.5)	7 (12.7)	21 (38.2)
Former	224 (33.0)	40 ((17.9)	69 (30.8)	42 (18.7)	73 (32.6)
Diagnosis of heart disease or stroke	165 (24.3)	31 (18.8)	43 (26.1)	31 (18.8)	60 (36.3)

Note: In each variable, the total may not add up to 678 due to missing data.

[a]≤Elementary (until completed 4th grade); ≥High school to <Secondary education (from 5th but uncompleted secondary education) ≥Secondary education (completed secondary and higher).

[b]Classified according to Geriatric Depression Scale (GDS-Short form including 15 items), a score ≥5 indicates geriatric depression.

[c]Defined as systolic and/or diastolic blood pressure ≥140/90 mm Hg and/or participants' self-reported medical diagnosis of hypertension.

FIGURE 1 Frequencies for each one of the stressful life events considered.

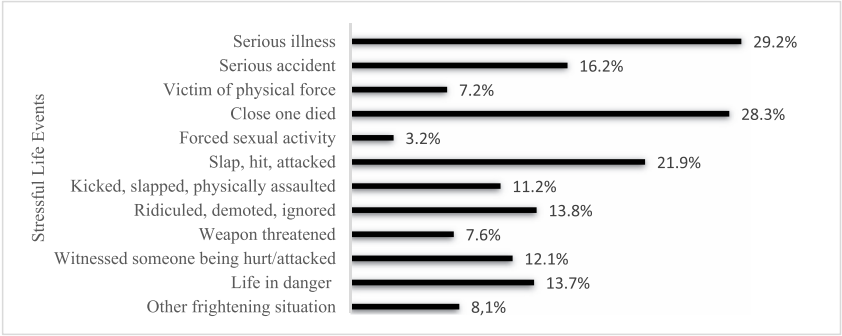

TABLE 2 The crude and multivariate-adjusted odds ratio for the association of stressful life events with heart disease and stroke.

	Diagnosis of heart disease and stroke			
	OR (95% CI)			
Stressful life events	Model 1	Model 2	Model 3	Model 4
0	1 (ref)	1 (ref)	1 (ref)	1 (ref)
1	1.16 (0.68–1.95)	1.19 (0.70–2.05)	1.18 (0.67–2.08)	1.17 (0.65–2.12)
2	1.53 (0.86–2.72)	1.60 (0.89–2.90)	1.56 (0.84–2.93)	1.50 (0.78–2.86)
≥3	2.32 (1.39–3.86)	2.36 (1.39–4.01)	2.11 (1.21–3.67)	2.00 (1.12–3.57)

Note: Model 1: adjusted for gender and age. Model 2: Model 1 + education + living alone + social support. Model 3: Model 2 + depression + self-rated health. Model 4: Model 3 + hypertension + alcohol consumption + smoking + physical exercise.

Abbreviations: 95% CI, 95% confidence interval; OR, odds ratio.

Wang et al., 2021), but also fail to account for earlier events that may have justified a long path leading to the disease (Kornerup et al., 2010; Kreatsoulas et al., 2019). The accumulation of stressful experiences in childhood and adulthood also contributes significantly to cardiovascular problems, which suggest a dose-response relationship (Clemens et al., 2021; Kreatsoulas et al., 2019). A full analysis of this association should be explored in longitudinal studies, with a record of the time at which SLE occurred, as well as its frequency and severity, which could allow for the establishment of a possible causal relationship between SLE and a higher risk of developing these diseases. Although each type of SLE considered is not age-dependent and most of them may have occurred at any stage of the life course, we computed a sensitivity analysis using not the sum of the SLE but the only SLE item solely related to childhood: have

been previously attacked, injured, or hit as a child. We repeated the same regression models with the same adjustments and the associations were similar (data not shown).

Some limitations of this study should be discussed. A diagnosis of heart disease or stroke has been self-reported, which can result to a considerable degree of error in ascertainment and recall bias (Barr et al., 2009; Choe et al., 2019; Machón et al., 2013). The accuracy of the self-reported data compared to the clinical records demonstrated that self-reported CVD events are unlikely to be missed. However, the concordance between both collection methods and the level of accuracy of self-report varies depending on the characteristics of the participants, the type of questionnaire and the method of administration (Barr et al., 2009), and should be used with caution for some endpoints such as stroke (Machón et al., 2013). Despite the limitations, cohort studies highlight that self-reported CVD measures are widely used in community-based studies (Jain et al., 2022) and the agreement between this method and a medical record is considered acceptable/good (Barr et al., 2009; Jain et al., 2022; Machón et al., 2013). Although the literature refers to self-reports as an acceptable tool, it is strongly advisable to use medical records when assessing CVD. Since heart disease and stroke have a major impact on people's quality of life, stroke remains the leading cause of long-term disability worldwide (Caprio & Sorond, 2019). These conditions are often associated with memorable symptoms (Choe et al., 2019), hospitalisation, and loss of ability and autonomy. This is intended to increase awareness of the conditions and decrease the likelihood that the event will be forgotten. For the same reason, participants who have recently had a CVD and are in the acute phase would be unlikely to be able to attend the interview or have the will to be interviewed at home.

One of the items on the SLE scale is the presence of a very serious illness. Since the aim of the study was to assess its relation to heart disease or stroke, we hypothesised that these CVD could be concomitantly considered as exposure and outcome. However, 63% of those who had heart disease or stroke did not report severe illness. Possibly because some of the events were mild and individuals had only momentary mild symptoms that they did not attribute much importance to, or because their disease had stabilised. As a sensitivity analysis, we repeated the analysis, excluding those who concurrently reported a prior diagnosis of heart disease, stroke, and very serious illness. The association with CVD had not changed significantly (data not shown), confirming exposure to a serious illness assessed in the SLESQ that transcends CVD. Additionally, we stratified the same analysis by having/not having neurological, respiratory or musculoskeletal diseases. No differences were found (data not shown).

The SLESQ does not include a measure of the perception of the severity of SLE, which can be highly subjective for each individual. Additionally, neither the frequency nor the timing of each type of SLE was considered. 'Stress is the outcome of a person's cognitive assessment of a situation' (Saadati et al., 2021), and the magnitude of the psychological impact of any event depends on each participant's perception and their coping strategies (Browall et al., 2016; Saadati et al., 2021). Thus, future studies should better characterise each SLE, namely considering when it occurred, its frequency, and its psychological impact on the individual. Along with this, the design of the cross-sectional study limited the ability to make inferences about causal relationships. Future longitudinal studies specifically designed to assess SLE throughout the life course are needed to test the possible behavioural and biological pathways that link SLE exposure to CVD events.

The EPIPorto cohort had differential losses to follow-ups over time, particularly among those who were socially disadvantaged, which may underestimate the prevalence of SLE and heart disease or stroke.

Despite the limitations, this paper provides a better understanding of the role of SLE as a possible risk factor for heart disease or stroke, and the results raise important issues that need to be followed up in future studies. A deeper understanding of the contribution of SLE to heart disease and stroke should be sought by using longitudinal studies to allow the temporal ascertainment of SLE in relation to heart disease and stroke and the analysis of causality. It is also recommended that a more detailed scale should be used to access SLE, identifying the point in life at which SLE occurred and the frequency of each event. A previous diagnose of CVD should be captured by more accurate measures, such as clinical records.

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CONFLICT OF INTEREST STATEMENT

The authors have declared that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

Data can be made available upon request to the EpiPorto coordination (henrique.barros@ispup.up.pt).

ETHICS STATEMENT

The Joint Ethics Committee of Hospital São João and the University of Porto Medical School approved this study protocol (CES-320/2016). Written informed consent was obtained from the participants.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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