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Childhood trauma and lifetime syncope burden among older adults

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ABSTRACT

Objective: Vasovagal syncope is governed by the autonomic nervous system and often precipitated by highly salient emotional situations. We hypothesized that a lifetime tendency towards vasovagal syncope may be precipitated by exposure to childhood trauma.

Methods: We examined data from the first wave of The Irish Longitudinal Study on Ageing (TILDA) of adults aged 50 + (n = 6497) who were asked to report lifetime syncope frequency and any history of childhood sexual or physical abuse. Mediation analysis was used to assess the relative importance of pathways via which childhood trauma could plausibly increase risk of later life recurrent syncope including via depression, mid-life cardiovascular disease and frequent syncope in youth.

Results: 18.2% reported a lifetime syncopal event: 4.0% frequent syncope in youth and 1.5% recurrent syncope in the last year. 10.9% reported childhood sexual or physical abuse, rising to 14.2% among those reporting any lifetime syncopal event, 21.0% with frequent syncope in youth and 20.2% with recurrent syncope in later life. In fully adjusted logistic regression models the report of childhood sexual or physical abuse was independently associated with frequent syncope in youth (OR 1.85 (CI 95% 1.27–2.71); p = 0.001; OR 2.14 (1.48–3.10); p < 0.001 respectively). A history of frequent syncope in youth and depression partially mediated the relationship between childhood sexual and physical abuse and recurrent syncope in later life, while mid-life cardiovascular disease was less important.

Conclusion: Childhood trauma may contribute to a lifelong vasovagal tendency. Early attention should be given to the potential precipitating and perpetuating psychosocial factors affecting recurrent syncope.

1. Introduction

Up to 40% of the population will experience at least one syncopal event during their lifetime – the majority of which will be attributable to the 'common faint', otherwise known as neurally mediated vasovagal syncope (VVS) [1]. In VVS, transient loss of consciousness results from cerebral hypoperfusion induced by reflex peripheral vasodilatation and/or bradycardia – although the exact mechanisms remain incompletely understood [2]. Clinical features include a typical prodrome of dizziness, unsteadiness and blurred vision, followed by brief self-limiting loss of consciousness and loss of postural tone, then complete and rapid recovery. Triggers are usually readily identifiable and may be physiological (e.g. prolonged orthostasis) and/or psychological (e.g. blood injury phobia) [3].

VVS affects all ages and may negatively impact quality of life, particularly if recurrent [4]. Childhood sexual and physical abuse are known to be associated with a broad range of poor health outcomes even into later life [5]. Although several small clinical studies have suggested higher rates of childhood maltreatment in those with syncope [6,7], a recent meta-analysis synthesizing the evidence to date on links between childhood sexual abuse and somatic outcomes specifically highlighted insufficient evidence relating to syncope [8]. Various pathways could plausibly link childhood trauma and syncope later in life including poor cardiovascular health in mid-life, poor mental health, and altered autonomic function [7–11].

Clinical history is the key to diagnosis in VVS [12]. The pattern with which syncope occurs across a lifetime can be highly indicative of a VVS tendency – e.g. the experience of frequent syncope in youth. VVS most commonly has its onset in the post-pubertal period with a female preponderance [13]. The incidence of childhood sexual and physical abuse also peak in this age group, and follows a similar sex distribution [14]. VVS is classically associated with readily identifiable triggers including highly salient emotional situations, hence 'trait faintness' has been suggested as an important stress-response in humans [15]. Across the lifespan syncope incidence has a bimodal distribution, with a second peak occurring after 65 years [16]. Those who have a history of VVS in youth are more likely to represent with events which are also attributable to VVS in later life [13]. These syncopal events, perhaps

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with an interlude lasting decades, are seen as a recurrence of the same underlying tendency and hence VVS has been likened to other chronic diseases which have a relapsing-remitting course [17].

Syncope however may also herald a more malign diagnosis particularly in older adults in whom a cardiac cause must be considered [18]. Syncope may thus pose a diagnostic dilemma and often precipitates extensive high-cost, low-yield investigations; yet even in older adults, a definitive cause will remain elusive in up to 50% [19]. Childhood trauma has been associated with elevated mid-life cardiovascular risk [9], however a cardiac cause of syncope, particularly when examined at the population level, is less likely to account for frequent syncope in youth [16].

VVS and psychiatric diagnoses commonly co-occur and may affect the course and recurrence of syncopal events [20]. Depression is more common in those with syncope [4], and an elevated risk of depression is a known sequela of exposure to childhood trauma [10,19]. Among the psychiatric diagnoses regularly encountered in syncope clinic populations is 'psychogenic pseudosyncope' [6] believed to be akin to 'non-epileptic attacks' which in the neurology literature have been consistently linked to higher rates of childhood trauma [21]. Such dissociative events may account for up to 6% of referrals to specialist tertiary care syncope units [12] although this may be a significant underestimate. Seeking a history of psychological trauma remains an important element in the psychiatric evaluation of those presenting with such dissociative phenomena, however both the etiological and diagnostic relevance of such reports are debated [22].

We sought to explore associations between a history of childhood sexual and physical abuse and lifetime syncope burden in a large population-based sample of older adults aged 50 + .

Hypotheses under investigation:

1. Given established links between childhood trauma and both mid-life cardiovascular disease and depression we expected that childhood sexual and physical abuse would be related to recurrent syncope in later life via these mediators.

2. We additionally hypothesized that similar to the effect seen in other chronic diseases, a life time tendency towards VVS or 'trait-faintness' may be precipitated by exposure to childhood trauma. We thus expected that those exposed to childhood sexual and physical abuse would report a greater lifetime burden of syncopal events - particularly in a pattern suggestive of a tendency towards VVS e.g. those with a history of recurrent syncope in youth.

3. Given the recognition that a predisposition to VVS starts early and may persist for decades, we further expected that frequent syncope in youth would mediate any relationship between childhood trauma and recurrent syncope in later life, even after accounting for other plausible pathways linking syncope to childhood trauma including cardiovascular disease and poorer mental health.

2. Methods

2.1. Sample

This analysis is based on data from the first wave of The Irish Longitudinal Study of Ageing (TILDA), conducted 2009–2011. This is a population-based, nationally representative study of community-dwelling adults aged 50 and over. The TILDA data collection process has been described in detail elsewhere [23]. Briefly, participants were assessed in their own home by means of a Computer Assisted Interview delivered by a trained interviewer. They were also invited to return a Self-Completion Questionnaire, which they completed unsupervised and which collected information on more sensitive topics. In total 8175 participants aged 50 and older enrolled in the TILDA cohort of whom 6636 returned the Self-Completion Questionnaire - which included questions on childhood sexual and physical abuse. < 2% (n = 139) of those who returned the Self-Completion Questionnaire were missing on any of the variables of interest resulting in a final sample of 6497 participants.

2.2. Ethics

Trinity College Research Ethics committee granted ethical approval for the study. Each participant provided written informed consent prior to enrolment in the study.

2.2.1. Outcome variables

2.2.1.1. Assessment of syncope burden. Three questions were used to record lifetime syncope burden:

1. Lifetime event: 'Have you ever had a blackout or fainted?' responses were coded as a binary categorical variable i.e. never = 0/ever = 1.

2. Vasovagal tendency in youth: 'Were you a frequent fainter when you were younger?' with answers coded as a binary categorical variable i.e. no = 0/yes = 1.

3. Recurrent late life syncope: 'Approximately how many times have you had a blackout or fainted in the last year?' a binary categorical variable was coded to indicate those participants with recurrent (≥ 2) reported syncopal episodes in the last twelve months i.e. recurrent syncope in the last year no = 0/yes = 1.

2.2.2. Primary predictor variables

2.2.2.1. Assessment of childhood trauma. As per the US population-based Health and Retirement Study [10], a history of childhood abuse was collected by four questions querying a history of sexual or physical abuse prior to the age of 18 by parents or others: 'Before you were 18 years old, were you ever sexually abused by either of your parents?', 'Before you were 18 years old were you ever sexually abused by anyone other than your parents?'; 'Before you were 18 years old, were you ever physically abused by either of your parents?', 'Before you were 18 years old were you ever physically abused by anyone other than your parents?'. Responses to these questions were coded to produce to two binary categorical variables: history of childhood sexual abuse no = 0/yes = 1; history of childhood physical abuse no = 0/yes = 1.

2.2.2.2. Covariates. Age, sex and education were recorded, as was smoking history (current, past, never). Co-morbid somatic conditions were recorded as the number of self-reported doctor-diagnosed conditions including: asthma, lung disease, arthritis, osteoporosis, diabetes, peptic ulcer disease, cancer and hip fracture. These were summed to give a total number of age-related chronic physical co-morbidities. Further relevant cardiovascular/cerebrovascular conditions were recorded to include: angina, myocardial infarction, heart failure, stroke, Transient Ischemic Attack, hypercholesterolemia, structural heart disease and arrhythmia. The total number of cardiovascular conditions was then summed and recoded as 0, 1, 2 or more, and was later added to regression models as a categorical variable.

The total number of prescribed medications was recorded in the participant's home and coded using the World Health Organizations Anatomical Therapeutic Chemical index [24]. Those participants who were taking 5 or more regular medications were defined as subject to 'polypharmacy'.

Levels of depressive symptoms over the previous week were recorded using The Center for Epidemiological Studies Depressions Scale (CES-D) [25]. Each question offers a four-point response scale with options ranging from, "Rarely or none of the time (less than 1 day)" to "All of the time (5–7 days)". This is a 20-item questionnaire, which produces a total score ranging from 0 to 60 and is validated for

use in epidemiological populations. Higher scores indicate greater levels of depressive symptoms [26].

Delayed word recall score was used as a measure of cognition [27]. In this test ten common words are presented orally which the participant is asked to remember, the number of words recalled after a short delay is recorded with higher scores indicating better recall.

2.3. Statistical analysis

All statistical analysis was conducted using the statistical software package Stata v12. Appropriate descriptive statistics were employed to describe the population according to a history of lifetime syncope burden. Using multivariable adjusted binary logistic regression we investigated associations of childhood sexual and physical abuse with syncope burden. Separate models were run with childhood sexual or physical abuse as the independent variable of interest and syncope burden (lifetime syncopal event *or* history of frequent syncope in youth *or* recurrent syncope in the last year) as the dependent variable. Covariates including age, sex, education, cardiovascular disease, co-morbidity, smoking history, polypharmacy and current depressive symptoms were added to this model and changes in the relationship between childhood trauma and syncope burden were examined. Where late life recurrent syncope was the outcome of interest, these models were adjusted for frequent syncope in youth. Interactions between childhood sexual and physical abuse were tested, as were interactions between the trauma variables of interest and sex. Finally, formal mediation analysis was performed using the Stata macro 'binary mediation' [28] in an attempt to better understand the relative effects of hypothesized life-course factors in mediating the relationship between childhood trauma and recurrent late life syncope (see Fig. 1 for conceptual pathway). We also calculated the proportion of the total mediating or "indirect" effect as a proportion of the total effect, and the proportion of each putative mediator's indirect effect as a proportion of the total indirect effect. This was followed by a bootstrapping procedure [29], clustered by household, to obtain standard errors for the indirect effects and their proportions along with 95% confidence intervals.

Table 1a
Characteristics of sample by lifetime history of syncopal event.[a]

	Total sample n = 6497	Never n = 5316 (81.8%)	Ever n = 1181 (18.2%)	p-Value
Demographics				
Age (mean (SD))	63.39 (9.5)	63.48 (9.5)	62.96 (9.4)	0.042
Education n (% primary only)	1775 (27.0)	1454 (27.3)	304 (25.7)	< 0.001
Gender n (% female)	3539 (54.6)	2825 (53.1)	714 (60.5)	< 0.001
Childhood trauma				
Any history of abuse n (%)	706 (10.9)	538 (10.1)	168 (14.2)	< 0.001
Childhood sexual abuse n (%)	440 (6.8)	329 (6.2)	111 (9.4)	< 0.001
Childhood physical abuse n (%)	479 (7.4)	366 (6.9)	113 (9.6)	0.001
Mental health & cognitive health				
Depressive symptoms[b], (median (IQR))	3 (7)	3 (6)	4 (8)	< 0.001
Cognition[c] (mean (SD))	5.99 (2.3)	5.94(2.3)	6.19(2.3)	> 0.99
Comorbidity & cardiovascular risk				
CVD conditions n (% ≥ 2)	777 (12.0)	557 (10.5)	220 (18.6)	< 0.001
Chronic conditions n (% ≥ 2)	1116 (17.2)	852 (16.0)	264 (22.4)	< 0.001
Polypharmacy n (%)	1327 (20.4)	1019 (19.2)	308 (26.1)	< 0.001
Current smoker n (%)	1084 (16.7)	861 (16.2)	223 (18.9)	0.030

CVD = cardiovascular conditions; polypharmacy = five or more regular medications.
IQR: interquartile range; SD: standard deviation
[a] Lifetime history of syncopal event i.e. Ever fainted (no/yes).
[b] Center for epidemiological studies depression scale score.
[c] Delayed word recall score.

In sensitivity analysis we repeated all regression models further adjusting for a history of self-reported ill-health in childhood and poverty in childhood, as potential alternative explanations for the associations reported. In addition, given that CES-D is a short-term assessment of depressive symptoms, we repeated all mediation analyses replacing CES-D in models with a lifetime self-reported doctor's diagnosis of a depressive disorder.

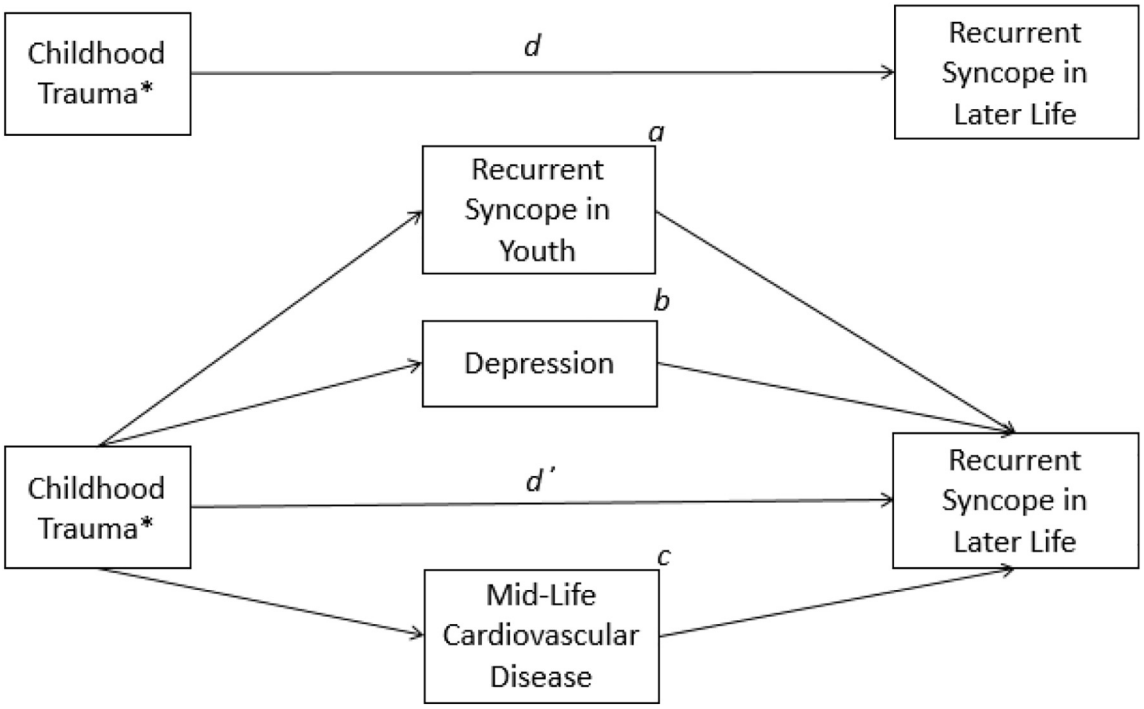

Fig. 1. Conceptual pathways leading from childhood trauma* (i.e. a history of childhood sexual or physical abuse) to recurrent syncope in later life. Total effect d = d′ + a + b + c; total direct effect = d′; total indirect effect = a + b + c.

Table 1b
Characteristics of sample by lifetime syncope burden.[a]

	Ever *n* = 1181 (18.2%)	Frequent in youth *n* = 262 (4.0%)	Recurrent episodes in the last year *n* = 94 (1.45%)
Demographics			
Age(mean (SD))	62.96 (9.4)	62.52(8.8)	63.12(9.9)
Sex *n* (% female)	304 (25.7)	209(79.8)	59 (62.8)
Education *n* (% primary only)	714 (60.5)	66(25.2)	30(31.9)
Childhood trauma			
Any history of abuse *n* (%)	168 (14.2)	55 (21.0)	19 (20.2)
Childhood sexual abuse *n* (%)	111 (9.4)	36 (13.7)	12 (12.8)
Childhood physical abuse *n* (%)	113 (9.6)	39 (14.9)	17 (18.1)
Mental health & cognitive health			
Depressive symptom[b] (median (IQR))	4 (8)	4(8)	5(12)
Cognition[c] (mean (SD))	6.19(2.3)	6.43(2.4)	5.95 (2.4)
Comorbidity & cardiovascular risk			
CVD conditions *n* (% ≥ 2)	220 (18.6)	51(19.5)	23(24.5)
Chronic conditions *n* (% ≥ 2)	264 (22.4)	74(28.2)	29(30.9)
Polypharmacy *n* (%)	308 (26.1)	64(34.8)	37(39.4)
Current smoker *n* (%)	223 (18.9)	51(19.5)	23(24.5)

IQR = interquartile range; SD = standard deviation; polypharmacy = five or more regular medications; CVD = cardiovascular conditions.

[a] Lifetime syncope burden i.e. ever fainted (no/yes); frequent fainting in youth (no/yes); recurrent syncope in later life (≥ 2 events in the last 12 months: no/yes).

[b] Depressive symptoms = Center for Epidemiological Studies Depression Scale score.

[c] Cognition = delayed word recall score.

3. Results

Of the total analysis sample (n = 6497), 18.2% (n = 1181) reported a lifetime history of syncope. Compared to participants with no lifetime history of syncope, participants who reported any episode also reported higher rates of physical health co-morbidities, including higher levels of cardiovascular disease and greater current depressive symptoms. Participants with any lifetime history of syncope did not differ on tests of cognitive function relative to those without a history of syncope (Table 1a).

4.0% (n = 262) of the sample additionally reported a history of frequent syncope in youth with 1.5% (n = 94) of the sample having experienced recurrent syncope in the last year (Table 1b). Of those who reported frequent syncope in youth and those reporting recurrent syncope in the last twelve months, a majority were female (79.8%(n = 209) and 62.8% respectively (n = 59)).

In multivariable adjusted binary logistic regression analysis the relationship between childhood trauma and the report of any lifetime history of syncope was similar across those with a history of sexual abuse (OR 1.29 (CI 95% 1.03–1.63)) and those with a history of physical abuse (OR 1.22 (CI 95% 0.97–1.53)), although after full adjustment for all covariates there was no longer a statistically significant relationship with physical abuse (Table 2). Both childhood sexual and physical abuse were associated with a history of frequent syncope in youth. The associations were statistically significant and large even after adjustment for a history of later life syncope.

A history of childhood physical abuse was independently associated with increased odds of recurrent syncope in the past twelve months (OR 1.91 (CI 95% 1.08–3.39)) – a relationship which was independent of adjustment for all covariates. Given the smaller number of cases reporting recurrent syncope in later life however, the standard errors of the estimates were larger (Table 2). The association between childhood sexual abuse and recurrent late life syncope was no longer significant after full adjustment; in addition the effect size was smaller than that for the effect of childhood physical abuse.

Using mediation analysis to examine pathways linking childhood trauma to recurrent late life syncope allowed us to understand that the effect of both childhood sexual and physical abuse on later life recurrent syncope was partially mediated. Table 3 displays the proportions of the total effect (*d in* Fig. 1) which was mediated (total indirect effect i.e. a + b + c *in* Fig. 1). 0.42 (0.13–2.59) of the total effect of sexual abuse on recurrent syncope in later life was mediated by the combination of the hypothesized pathways, of which the proportion mediated via frequent syncope in youth was 0.60 (0.37–0.85) and via depressive symptoms was 0.34 (0.14–0.58). With regard to physical abuse, 0.30 (0.17–1.03) of the total effect was mediated: 0.57 (0.36–0.81) via frequent fainting in youth and 0.34 (0.11–0.53) via depression. 0.06 (− 0.06–0.20) of the indirect effect from childhood sexual abuse to recurrent syncope in later life was mediated via established cardiovascular disease, while the equivalent proportion for childhood physical abuse was 0.10 (0.001–0.28), although these were estimated with less precision than the other pathways.

The predictive power of the logistic regression models was not improved when examining the additive and multiplicative effect on syncope risk of experiencing both sexual and physical abuse. Interaction terms between sex and either form of childhood maltreatment under investigation were not significant.

3.1. Sensitivity analysis

After examination of models further adjusted for a history of self-reported ill-health or poverty in childhood any substantive conclusions regarding the size and direction of associations remained unchanged. Similarly, mediation analysis using a self-reported diagnosis of a depressive disorder in place of the CES-D demonstrated a similar proportion of the indirect effects were mediated via mental health.

4. Discussion

In this large population-based cohort, exposure to childhood sexual abuse was independently associated with the report of any lifetime episode of syncope and also with the experience of frequent syncope in youth. Childhood physical abuse was related to reports of frequent syncope in youth and recurrent syncope in later life. These relationships persisted even after adjustment for a wide range of covariates including demographics, depressive symptoms, physical co-morbidities and cardiovascular risk. In formal mediation analysis investigating pathways by which childhood trauma could plausibly affect later life recurrent syncope, frequent syncope in youth was shown to partially mediate the relationship - a pathway in keeping with childhood trauma contributing to a lifelong predisposition towards VVS [17] or 'trait faintness' [15].

Several small clinical studies have suggested that childhood sexual and physical abuse may be clinically relevant in those presenting with syncope. A recent study based in a specialist tertiary-referral syncope clinic which described the semiology of psychogenic pseudosyncope (a dissociative disorder) reported that childhood sexual or physical abuse was present in 11.6% of patients [6] and work from the same group has also recently reported that VVS and PPS co-occur [30] potentially suggesting a common etiological pathway. Furthermore, an investigation of childhood syncope referrals in a pediatric unit suggested that psychosocial stressors, including maltreatment and familial discord, were common potential precipitants of recurrent unexplained syncopal events [7].

VVS is arguably the most overt, and common, manifestation of autonomic malfunction [3,31]. Thus our findings are in keeping with research suggesting a link between childhood sexual and physical abuse and altered autonomic equilibrium [32,33]. Of those who experience any lifetime syncope, the majority will have had an event attributable

Table 2
Multivariate Binary Logistic Regression Analyses: models showing associations of lifetime syncope burden[a] with childhood trauma[b]; coefficients of childhood trauma are reported as odds ratios (OR) and 95% confidence intervals (CI).

	Lifetime syncopal event[c]		Frequent syncope in youth[c]		Recurrent syncope in later life[d]	
	OR (CI 95)	*p*-Value	OR (CI 95)	*p*-Value	OR (CI 95)	*p*-Value
Childhood sexual abuse	1.29 (1.03–1.63)	0.030	1.85(1.27–2.71)	0.001	1.36 (0.71–2.62)	0.35
Childhood physical abuse	1.22 (0.97–1.53)	0.091	2.14(1.48–3.10)	< 0.001	1.91 (1.08–3.39)	0.026

[a] Lifetime syncope burden i.e. ever fainted (no/yes); frequent fainting in youth (no/yes); Recurrent syncope in Later Life (≥ 2 events in the last 12 months: no/yes) with separate models for each outcome.
[b] Childhood trauma i.e. childhood sexual or childhood physical abuse (no/yes) with separate models for each exposure.
[c] Model additionally adjusted for age, sex, education, smoking history, cardiovascular conditions, co-morbidity, polypharmacy, depression, delayed word recall.
[d] Model additionally adjusted for age, sex, education, smoking history, cardiovascular conditions, co-morbidity, polypharmacy, depression, delayed word recall & history of frequent syncope in youth.

Table 3
Binary mediation analyses where childhood trauma[a] is the independent variable and recurrent syncope in later life[b] is the outcome variable with frequent syncope in youth, depressive symptoms and cardiovascular disease as putative mediators. Co-efficients are presented as proportions (ratios) with 95% bias corrected (BC) confidence intervals (CI).

	Childhood sexual abuse		Childhood physical abuse	
	Proportion	Bootstrap 95% BC CI	Proportion	Bootstrap 95% BC CI
Total Indirect effect [c]((a + b + c) / (a + b + c + d′) = (a + b + c) / d)	0.42	(0.13–2.60)	0.30	(0.17–1.03)
Frequent syncope in youth[d] [c](a / (a + b + c))	0.60	(0.37–0.85)	0.57	(0.36–0.81)
Depression[e] [c](b / (a + b + c))	0.34	(0.14–0.58)	0.33	(0.11–0.53)
Cardiovascular conditions[f] [c](c / (a + b + c))	0.06	(− 0.06–0.20)	0.10	(0.001–0.28)

[a] Childhood trauma i.e. childhood sexual or childhood physical abuse (no/yes) with separate models estimated for each exposure.
[b] Recurrent syncope in Later Life (≥ 2 events in the last 12 months: no/yes).
[c] Pathway effects calculated as proportions denoted as per conceptual pathways in Fig. 1.
[d] Frequent fainting in youth (no/yes).
[e] Center for Epidemiological Studies Depression Scale score.
[f] Two or more self-reported cardiovascular conditions.

to VVS, similarly those with a history of frequent syncope in youth [16]. The exact mechanism underpinning VVS remains poorly understood but may result from paradoxical parasympathetic overdrive [17] in response to a sympathetic increase in heart rate. In face of threat the recruitment of the parasympathetic division of the autonomic nervous system may serve as a means of self-soothing thus higher levels of parasympathetic tone may be adaptive [15]. Indeed 'trait faintness' has been likened to 'tonic immobility' [31] in mammals and may be an important omission from the commonly understood stress-response in humans [15]. However although such defense mechanisms in animals may share a common evolutionary basis, loss of consciousness is unique to humans and thus potentially less adaptive [34].

A stress response may be decoupled from the original acute stressor i.e. so that a stress response occurs despite no ongoing threat - as occurs in panic disorder [35] or post-traumatic stress disorder [36]. It is thus plausible that a VVS tendency may become habituated in youth in those exposed to childhood trauma, and persist throughout one's lifetime. VVS and psychological responses to childhood trauma may therefore have common neural substrates i.e. childhood trauma may lead to alterations in brain regions with relevance to both VVS and psychological responses. For example, relative to healthy controls neuroimaging has identified differences in caudate gray matter volume both in those with recurrent VVS [37]and in those with a history of childhood sexual abuse [38].

In line with our hypothesis we also report evidence that there may be an indirect effect of childhood sexual and physical abuse on recurrent late life syncope mediated via depression. Depression has previously been related to syncope in older adults [39] and has repeatedly been shown to have a higher prevalence in those who experienced childhood sexual and physical abuse [10]. Prior studies have pointed to the high burden of psychiatric co-morbidity particularly among those with recurrent unexplained syncope [20,40]. Thus, in common with other studies investigating psychological correlates of syncope [4,20], our results demonstrate that mental health may be an important determinant of elevated syncope risk.

We found less evidence of mediated relationships via mid-life cardiovascular disease, while there was an independent direct association between childhood physical abuse and late life recurrent syncope. Childhood abuse may increase even mid-life sub-clinical cardiovascular risk [9], therefore it is possible that a reliance on established cardiovascular diagnoses underestimated mediated effects via this pathway. In estimation of the direct effects however, we did control for both cardiovascular behavioral risk markers (smoking) and conditions that increase cardiometabolic risk (diabetes) via which an effect of childhood trauma could also translate into increased syncope risk in later life. Among older adults presenting with syncope, a cardiac cause is more likely than in younger adults [16]. Even among elders however, the most common etiology remains neurocardiogenic i.e. VVS or orthostatic hypotension [41] (defined by American Autonomic Society as a fall in systolic blood pressure ≥ 20 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg occurring within 3 min of standing from the supine position [42]).

While in this sample childhood physical abuse remained independently associated with recurrent syncope in the last twelve months, childhood sexual abuse did not. The effect sizes were similar in relation to the effect of childhood sexual and physical abuse across each of the syncope outcomes except in recurrent later life syncope. It is however important to note that the precision of the estimates for later life syncope were lower, in part determined by the lower rate of cases of later life syncope (< 8% of lifetime and < 36% of youth syncope). We did not find evidence of increased risk of syncope in those exposed to both childhood sexual and physical abuse nor of increased sex specific risk.

In this cohort we were unable to definitively delineate the type of syncope experienced, and may have captured heterogeneous causes of syncope - particularly with regard to those events which occurred within the last twelve months in older adults. It is accepted that the most important element in the diagnosis of VVS is clinical history [12]. The lifetime pattern of events, such as frequent events occurring in youth and recurring in later life, is strongly suggestive of an underlying

tendency towards VVS [13]. Furthermore, although we did not capture the age of participant's syncopal events in 'youth' we expect that these are in line with data (which was internationally consistent) suggesting that the peak of syncope onset in 'youth' is at 13 years [13].

Both childhood sexual and physical abuse and syncope burden were self-reported. The lifetime prevalence of syncope in this cohort is lower than prior reports of up to 40% [16] however a population-based sample of adults aged 45 + (median age 62 years) in Olmsted County, Ohio, USA estimated a similar lifetime prevalence of syncope of 19% [43]. Kenny et al. [44] suggest that differences in reported syncope prevalence may be explained by varying methods of syncope ascertainment e.g. the use of a single item question rather than detailed syncope interview or case adjudication, and the population under investigation. In the current study potential ambiguity in the terms 'faint' and 'frequent' in the questions on syncope history may have resulted in under-reporting. Given the nature of studies investigating the outcomes of childhood sexual and physical abuse, the majority are based on self-report retrospective data [45]. In this study we were unable to investigate differences in outcomes based on the severity or duration of these stressors. We note however that the prevalence of childhood abuse in this population is in keeping with more detailed investigations in the Irish population - being consistent with the prevalence of the more severe forms of childhood abuse [46].

This study uses retrospectively recalled data that was collected within a cross-sectional framework in an attempt to delineate life course pathways in older adults, therefore we cannot rule out reverse causality. We suggest however that given the temporal ordering of the events, reverse causality is unlikely. Poor or inaccurate recall of trauma or syncopal events may be of further concern in an ageing cohort in whom a higher prevalence of syncope may be expected [47], however we controlled for a measure of cognitive function and note that the mean age of this sample is only ~63 years. Moreover given the salient nature of events under investigation (i.e. childhood trauma and syncope) they are perhaps more likely to be recalled with accuracy than other retrospectively collected information [48]. Additionally, we note that sensitivity analyses adjusting for other childhood stressors such as childhood ill-health and poverty did not attenuate the associations described.

Further research is required to investigate the potential links between a history of childhood sexual and physical abuse and syncope, particularly in those who present with a history indicative of an underlying tendency towards VVS. Even decades after the initial exposure, those with a history of childhood sexual and physical abuse may be at greater risk for recurrent syncope. Early attention should be given to the potential precipitating and perpetuating psychosocial factors affecting syncope.

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Competing interest statement

All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf and declare that the authors have no competing interests to report.

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