




Childhood adversities and long-term sleep problems: The mediating role of affective symptoms. A prospective population study[☆]

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ABSTRACT

Introduction: Sleep disturbances are known to impact mental and physical health. In cross-sectional population studies, adverse childhood experiences (ACEs) associate with sleep problems (SPs), with potential variations by sex. In a prospective population study, we tested whether the effect of ACEs on SPs differs between males and females.

Method: In a Finnish population-based study, 3142 individuals aged 30–64 years (56 % female) completed questionnaires about ACEs in 2000 and SPs in 2000 and in 2011. The effects of ACEs on SPs were analysed using repeated measures ANOVA and path analyses.

Results: Multiple ACEs associated with subjective SPs in adulthood, even after controlling for sex, age, marital status, education, income, smoking, alcohol abuse, chronic illness, and continuous pain. Of the ACE dimensions, social disadvantage was associated with SPs in both sexes. The effects of multiple ACEs and social disadvantage on SPs were partially mediated by affective symptoms, depression and anxiety. Family conflicts and maternal mental health problems associated with SPs only in females, and this association was also mediated via affective symptoms.

Conclusion: ACEs, especially social disadvantage, are associated with SPs in the adult general population. This prospective study suggests sex differences in the observed associations. Specifically, family conflicts and maternal mental health problems associate with SPs in females only, with the affective symptom domain as the main mediator. For effective treatment of long-term SPs, it is important to investigate patients' childhood living conditions and their childhood family's emotional atmosphere. Childhood psychological distress requires attention particularly in females.

1. Introduction

Adverse childhood experiences (ACEs) profoundly and persistently affect an individual's physical and mental health and wellbeing [1]. Moreover, ACEs are associated with several risk factors for poor health. These risk factors include unemployment, low socioeconomic status, disability retirement [2–8], and mortality [9,10]. Furthermore, ACEs are associated with various mental disorders, including depression, anxiety,

and suicidality [11–16]. Although ACEs are risk factors for various disturbances in adulthood regardless of sex, different ACE subtypes may be associated with specific symptoms. Abuse may be particularly associated with psychopathology in women, whereas neglect may have a stronger association with psychopathology in men [17].

Variiously defined sleep problems (SPs) are frequent in general population and constitute a significant risk for cognitive performance, mental and physical health, and overall mortality [18–23]. On the other

Abbreviations: ACEs, Adverse Childhood Experiences; SPs, Sleep Problems; SPs2000, Sleep Problems in 2000; SPs2011, Sleep Problems in 2011; SPsDIF, Difference between SPs2011 and SPs2000.

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hand, low social status or income, unemployment, significant life events such as divorce, and unhealthy lifestyle behaviour including tobacco smoking and alcohol abuse, are often associated with SPs [19,22–25]. SPs may vary also by sex [26–28].

In addition to mental and physical disturbances, ACEs also associate with SPs. In a recent systematic meta-analysis of 62 articles, ACEs associated significantly with poor sleep characteristics such as sleep duration and long-term SPs. A great majority of the reviewed studies were either cross-sectional or retrospective [29].

In a cross-sectional study of the Finnish working-age population, 13.4 % of males and 13.8 % of females reported quite poor or poor sleep quality. Multiple ACEs associated with sleep quality, even after adjusting for work status, use of psychotropic drugs, health behaviour, recent life events, and child-parent relationships. Frequent fear of a family member and serious conflicts in the family showed the strongest specific associations. In the analyses, data from women and men were pooled together, as the results showed similar associations across sexes [25]. In another Finnish cross-sectional study, 25 % of females and 21 % of males reported experiencing insomnia at least once a week. Childhood economic difficulties were associated with insomnia in both women and men, while current economic difficulties were associated with insomnia only among women [30].

In a Canadian cross-sectional population survey, an increasing number of ACEs associated proportionally with troubled sleep, even after controlling for sociodemographic, socioeconomic, health, and mental health factors. Additionally, troubled sleep was linked with psychological anxiety, older age, being female, being unmarried, white ethnicity, lower annual income, chronic pain, poor perceived health, and mental health difficulties were associated. Associations by sex were not analysed [22].

In a pre-birth cohort study of young adults (mean age 20.6 years), childhood maltreatment types — emotional, physical, sexual abuse, and neglect — generally did not predict poor sleep quality, except for physical abuse in males. Poor sleep quality was accounted for by concurrent factors such as social disadvantage, cigarette smoking, and internalising symptoms, including anxiety, depression, and withdrawal [31]. In a follow-up study of children, the average level of family conflict experienced between the ages of 7 and 15 years predicted insomnia at the age of 18. This association held true even after controlling for sex, socioeconomic status, SPs at the age of 9, and self-reported health, and depression at the age of 18 [32]. Furthermore, in a retrospective survey of Adult Health Maintenance Organization, all eight ACEs and their sum were associated with self-reported SPs [33]. In addition to depression and anxiety, ACEs have also been associated with SPs [34].

A great majority of the population studies concerning associations between ACEs and SPs have been either cross-sectional or retrospective. In these studies, sex differences have received little attention, and the role of affective symptomatology has remained obscure. In the present study, we aimed to study the effect of ACEs and their factor dimensions on SPs among working-aged general population, aged 30–64 years, using a prospective study setting. Participants older than 64 years were excluded due to possible recall errors of ACEs. Because ACEs and SPs may differ between sexes, we also aimed to study whether the effects of ACEs on SPs differ between males and females. Finally, we hypothesised that current affective symptoms, depression, and anxiety, which previous studies have associated with both ACEs and SPs, may act as mediators in these associations. This may provide important knowledge for SPs' treatment approaches.

2. Material and methods

This study is based on two Finnish multidisciplinary epidemiological surveys, the Health 2000 and the Health 2011 carried out by the Finnish Institute for Health and Welfare (THL, previously National Public Health Institute; <https://thl.fi/en/web/thlfi-en/research-and-development/research-and-projects/health-2000-2011>). In the Health 2000 study, a

regionally stratified sample representative of the Finnish population aged 30 years and older ($n = 8028$) was randomly selected, with 88 % agreeing to participate in the interview. All participants of the Health 2000 Survey, who were alive and had not refused further contact, were invited to participate in the Health 2011. A total of 5784 subjects participated in both studies. Of them, 3469 had provided information on ACEs in 2000. Participants older than 64 years ($n = 354$) were excluded due to possible recall errors [35], thus the final group comprises 3142 (1762 females) participants.

The basic interview comprised extensive data on the participants' background, health, and functioning. In the present study, sex, age, marital status, education (combination of basic and vocational education), and daily income were utilised as controls. Additionally, tobacco smoking, alcohol abuse (number of hangovers during the past year), self-reported health, chronic illness, and continuous pains and aches were used as control variables. The original items are shown in Supplementary material.

In 2000, the baseline survey presented with questions about ACEs. The subjects were instructed to respond with “no” (=0), “yes” (=1), or “cannot say” (=2) to each of the following questions: “When you think about your growth years i.e. before you were aged 16? 1. Did your family have long-term financial difficulties?, 2. Was your father or mother often unemployed although they wanted to work?, 3. Did your father or mother suffer from some serious disease or disability?, 4. Did your father have alcohol problems?, 5. Did your mother have alcohol problems?, 6. Did your father have any mental health problem, e.g., schizophrenia, other psychosis, or depression?, 7. Did your mother have any mental health problem, e.g., schizophrenia, other psychosis, or depression?, 8. Were there serious conflicts within your family?, 9. Did your parents divorce?, 10. Were you yourself seriously or chronically ill? and 11. Were you bullied at school? The sum of “yes” answers (0–11) represents childhood adversities.

All participants completed the 15D health-related quality of life questionnaire [36], in both 2000 and 2011. The 15D has been shown to be highly reliable, sensitive, and responsive to change [36]. It included questions on SPs, depression, and distress (anxiety). The question on distress was mainly defined by questions on anxiety; therefore, the term anxiety was used in present study (Supplementary material). SPs were assessed using a five-statement Likert scale in both 2000 and 2011: 1. I am able to sleep normally, i.e. I have no problems with sleeping, 2. I have slight problems with sleeping, e.g. difficulty in falling asleep, or sometimes waking at night, 3. I have considerable problems with sleeping, e.g. disturbed sleep, or feeling I have not slept enough, 4. I have great problems with sleeping, e.g. having to use sleeping pills often or routinely, or usually waking at night and/or too early in the morning, 5. I suffer from severe sleeplessness, e.g. sleep is almost impossible even with full use of sleeping pills or staying awake most of the night. Thus, we received identical assessments for sleep problems, denoted as SPs2000 and SPs2011. Moreover, participants completed identical questions on depression and anxiety in both 2000 and 2011 (Supplementary material).

2.1. Statistical analyses

Initially, distributions of SPs2000 and SPs2011 and their correlation were calculated (Table 1). The means (SD) of SPs at baseline and follow-up and their difference (SPs2011–SPs2000; SPsDIF) were calculated according to participants' background, and differences were assessed using Student's *t*-test (Table 2). The correlations between the number of ACEs, depression, and anxiety were also calculated. In ANOVA, the variance of SPsDIF was explained by background factors (Supplementary Table 1). In the repeated measures of ANOVA, the variance of SPs2000 and SPs2011 was explained by individual ACE items (Supplementary Table 2). Moreover, the means (SD) of SPs were calculated by individual ACE questions (Table 3).

Given that the ACE items constituted a heterogeneous group, they

Table 1
Seep problems in 2000 and 2011 and their intercorrelation.

	2000		2011	
	N	%	N	%
1 I am able to sleep normally	1646	52.4	1410	44.9
2 I have slight problems with sleeping	1284	40.9	1463	46.6
3 I have considerable problems with sleeping	147	4.7	172	5.5
4 I have great problems with sleeping	59	1.9	93	3.0
5 I suffer from severe sleeplessness	6	0.2	4	0.1
Total	3142	100	3142	100
Correlation coefficient and stational significance	0.474; <0.001			

were factorised, and the varimax-rotated component scores with eigenvalues greater than 1 were interpreted as Social disadvantage, Family conflicts and Maternal mental problems, and used as explanators for the variance in SPs (Supplementary Table 3). The means (SD) of ACE factor dimension scores were calculated by sex and tested using Student's t-test (Supplementary Table 4).

In the repeated measures ANOVA, the variance of SPs2000 and SPs2011 was initially explained by sex, age, marital status, education, income, sum of ACEs, and its factor dimensions in all participants and in males and females separately (Model 1). In the second phase, depression and anxiety in 2000 were included as independent variables (Model 2). Finally, also depression and anxiety in 2011 were entered into equation (Model 3) (Table 4). For sensitivity analyses, participants reporting at least considerable sleep problems in both SPs2000 and SPs2011 were considered as suffering from chronic SPs and they were compared to the participants with no SPs2000 and SPs2011 using logistic regression analyses.

For path analyses, the PROCESS macro in SPSS (model template 4) by Hayes [37] was used. In cross-sectional samples, this macro tests the direct and indirect effects of an independent variable (X) on a dependent variable (Y) while modelling a process in which X affects mediators (M), which in turn affect Y. In the present study, we applied a prospective model to analyse the effect of X (ACEs) on Y (SPs2011) with M (depression and anxiety in 2000 and 2011) as mediators. In post hoc analyses, depression 2011 or SPs2011 were dependent variables and SPs2000 and SPs2011 or depression in 2000 and 2011 correspondingly mediator variables (Supplementary Table 7). Analyses were carried out in males and females separately. The total effect of X on Y, as well as the direct and indirect effects through the mediators, are reported. These analyses were controlled for age, marital status, education, income, smoking, hangovers, chronic illness, and continuous pain.

The data were analysed using SPSS software (version 28.0 for Windows). P-values less than 0.05 (two-tailed) were considered statistically significant.

3. Results

At least considerable SPs were reported by 6.8 % of the participants in 2000 and by 8.6 % eleven years later. A strong correlation between SPs2000 and SPs2011 suggested their persistence (Table 1). Age, marital status (divorced/widowed), and income in 2000 were significantly associated with SPs2000, but these associations were not significant with SPs2011 (Table 2). Poor self-reported health, chronic illness, and pain at baseline were associated with sleep problems reported in SPs2000 and SPs2011 (Table 2). The difference between SPs2011 and SPs2000 (SPsDIF), indicates an increase in SPs from 2000 to 2011, significantly increased among females, participants aged 35–44, participants with secondary or high education, and those with higher income. Moreover, SPsDIF also increased significantly among participants with good health, no chronic illnesses, and no continuous pain (Table 2). Multivariate ANOVA for SPsDIF showed that sex, age, and perceived health explained the associations of other background factors. Specifically, participants who were female, younger, and reported good

Table 2
Means of sleep problem scores in 2000 (SPs2000) and 2011 (SPs2011) and their difference (SPs2011-SPs2000; SPDIF) by background factors.

Background factors in 2000	N	SPs2000		SPs2011		SPsDIF	
		Mean	SD	Mean	SD	Mean	SD
Total	3142	1.135	0.502	1.171	0.560	0.103	0.725
Sex;		0.556		0.052		0.001	
Mal	1380	1.129	0.491	1.149	0.526	0.053	0.699
Female	1762	1.140	0.510	1.188	0.584	0.142	0.743
Age; p		0.004		0.060		<0.001	
30-34	430	1.098	0.432	1.107	0.451	0.079	0.702
35-39	481	1.083	0.400	1.150	0.527	0.220	0.737
40-44	458	1.118	0.472	1.214	0.619	0.205	0.720
45-49	519	1.162	0.546	1.212	0.616	0.148	0.745
50-54	544	1.191	0.589	1.173	0.562	0.017	0.737
55-59	389	1.113	0.463	1.175	0.566	0.026	0.677
60-64	321	1.175	0.565	1.156	0.537	-0.022	0.705
Marital status; p		0.003		0.063		0.309	
Single	440	1.150	0.527	1.214	0.618	0.093	0.741
Married/Cohabitant	2204	1.117	0.470	1.156	0.537	0.114	0.691
Divorced/Widowed	498	1.201	0.602	1.201	0.602	0.060	0.847
Education; p		0.186		0.226		0.007	
Basic	797	1.163	0.547	1.198	0.598	0.033	0.753
Secondary	1132	1.125	0.485	1.154	0.533	0.128	0.677
High	1213	1.125	0.485	1.170	0.558	0.125	0.747
Income (Finnish Mark); p		0.003		0.106		0.004	
0-5000	156	1.256	0.671	1.244	0.656	-0.045	0.845
5001-10000	493	1.158	0.540	1.215	0.620	0.081	0.779
10001-15000	642	1.159	0.541	1.162	0.546	0.048	0.681
15001-25000	1143	1.114	0.463	1.165	0.550	0.139	0.750
25001+	708	1.105	0.445	1.144	0.517	0.141	0.645
Smoking; p		0.972		0.065		0.694	
No	937	1.135	0.501	1.143	0.516	0.095	0.721
Yes	2205	1.135	0.502	1.183	0.577	0.106	0.727
Hangover/year		0.001		<0.001		0.376	
0	1615	1.124	0.482	1.150	0.527	0.090	0.693
1-2	725	1.113	0.462	1.146	0.521	0.121	0.737
3-6	492	1.138	0.508	1.195	0.594	0.128	0.746
7-12	185	1.195	0.594	1.270	0.686	0.141	0.815
13+	125	1.304	0.701	1.352	0.765	0.008	0.828
Perceived health; p		<0.001		<0.001		<0.001	
Good	1272	1.057	0.332	1.116	0.468	0.156	0.679
Rather good	1020	1.100	0.436	1.159	0.541	0.144	0.721
Moderate	671	1.244	0.656	1.227	0.634	0.015	0.765
Rather poor	143	1.378	0.785	1.336	0.750	-0.182	0.784
Poor	36	1.889	1.008	1.778	0.989	-0.194	0.951
Chronic illness; p		<0.001		<0.001		0.015	
No	1864	1.082	0.396	1.121	0.477	0.129	0.681
Yes	1278	1.213	0.617	1.244	0.655	0.065	0.783
Continuous pain; p		<0.001		<0.001		0.004	
No	2875	1.109	0.455	1.149	0.525	0.114	0.719
Yes	267	1.412	0.810	1.412	0.810	-0.019	0.783

health, experienced a greater increase in SPs in 2011 compared to 2000 (Supplementary Table 1).

Number of ACEs was significantly and proportionally associated with SPs2000 and SPs2011 (Supplementary Fig. 1). Of the individual ACEs, financial difficulties, father's alcohol problems, both parents' mental health problems, family conflicts, the participant's chronic illness, and being bullied at school were associated with SPs2000 and SPs2011. These associations indicate long-lasting SPs (Table 3). When the effects of sociodemographic background and health factors were controlled, maternal alcohol problems associated with SPs in both sexes. Family conflicts and maternal mental health problems, and maternal mental

Table 3
Means of sleep problems in 2000 (SPs2000) and 2011 (SPs2011) by adverse childhood experiences (ACEs).

		N	SPs2000			SPs2011		
			Mean	SD	p	Mean	SD	p
1. Financial difficulties	No	2425	1.108	0.452		1.156	0.536	
	Yes	717	1.226	0.634	<0.001	1.223	0.630	0.005
2. Parents' unemployment	No	2946	1.134	0.501		1.170	0.558	
	Yes	196	1.143	0.516	0.820	1.184	0.579	0.748
3. Parents' diseases	No		1.124	0.483		1.164	0.549	
	Yes	743	1.170	0.558	0.031	1.194	0.592	0.208
4. Father's alcohol problems	No	2627	1.123	0.480		1.161	0.545	
	Yes	515	1.198	0.598	0.002	1.221	0.628	0.026
5. Mother's alcohol problems	No	3102	1.135	0.501		1.170	0.558	
	Yes	40	1.150	0.533	0.849	1.250	0.670	0.370
6. Father's mental health problems	No	3038	1.130	0.493		1.165	0.550	
	Yes	104	1.289	0.706	0.001	1.365	0.777	<0.001
7. Mother's mental health problems	No	3032	1.128	0.490		1.165	0.550	
	Yes	110	1.327	0.743	<0.001	1.346	0.759	0.001
8. Family conflicts	No	2604	1.121	0.476		1.151	0.528	
	Yes	538	1.205	0.606	<0.001	1.271	0.686	<0.001
9. Parents divorced	No	2858	1.134	0.500		1.168	0.555	
	Yes	284	1.148	0.524	0.649	1.204	0.607	0.298
10. Subject's chronic illness	No	3002	1.129	0.491		1.165	0.550	
	Yes	140	1.271	0.687	0.001	1.314	0.730	0.002
11. Subject bullied at school	No	2665	1.117	0.470		1.152	0.531	
	Yes	477	1.235	0.644	<0.001	1.277	0.691	<0.001
Number of ACEs	0	1321	1.083	0.400	<0.001	1.112	0.460	<0.001
	1–2	1275	1.146	0.520		1.201	0.601	
	3–4	421	1.200	0.600		1.204	0.606	
	5–6	111	1.342	0.757		1.378	0.787	
	7–11	14	1.429	0.852		1.429	0.852	
	All	3142	1.135	0.502		1.171	0.560	

Table 4
Repeated ANOVA for sleep problems in 2000 and 2011 for all, male and female participants. Significant associations **bolded**. Complete table is shown in [Supplementary Table 5](#).

All	Model 1			Model 2			Model 3		
	MSq	F	p	MSq	F	p	MSq	F	p
ACEs	28.616	45.109	<0.001	9.373	16.798	<0.001	4.613	8.709	0.003
Family conflicts	6.154	9.708	0.002	1.346	2.413	0.120	0.116	0.220	0.639
Social disadvantage	19.280	30.412	<0.001	7.402	13.266	<0.001	5.289	9.991	0.002
Mother's mental problems	5.526	8.716	0.003	1.863	3.339	0.068	0.930	1.756	0.185
Males	MSq	F	p	MSq	F	p	MSq	F	p
ACEs	15.998	25.908	<0.001	8.438	15.669	<0.001	5.965	11.529	0.001
Family conflicts	0.560	0.909	0.340	0.040	0.075	0.784	0.082	0.159	0.690
Social disadvantage	18.509	30.046	<0.001	11.750	21.890	<0.001	10.398	20.200	<0.001
Mother's mental problems	0.688	1.117	0.291	0.259	0.483	0.487	0.155	0.302	0.583
Female	MSq	F	p	MSq	F	p	MSq	F	p
ACEs	14.282	22.070	<0.001	2.928	5.116	0.024	0.782	1.453	0.228
Family conflicts	7.567	11.724	0.001	2.265	3.961	0.047	0.733	1.362	0.243
Social disadvantage	3.911	6.060	0.014	0.308	0.539	0.463	0.021	0.040	0.842
Mother's mental problems	5.918	9.169	0.002	2.244	3.924	0.048	1.189	2.210	0.137

ACEs = Adverse Childhood Experiences. MSq = Mean Square.

Model 1: Effects of background and health factors controlled.

Model 2: Effects of background, health factors and depression and anxiety in 2000 controlled.

Model 3: Effects of background, health factors and depression and anxiety in 2000 and 2011 controlled.

health problems alone, associated with SPs in females only, although the effect of depression and anxiety was controlled. Interestingly, financial problems and being bullied at school did not associate with SPs when the effect of sociodemographic background and health factors were controlled ([Supplementary Table 2](#)).

Factor analysis of 11 ACE items yielded three dimensions: 1. Family conflicts, 2. Social disadvantage, and 3. Mother's mental health problems ([Supplementary Table 2](#)). Chronic illness and being bullied at school were loaded under the Social disadvantage factor. Females reported more family conflicts and mother's mental health problems than males ([Supplementary Table 3](#)).

In repeated ANOVA, female sex, age, lower education, poor self-reported health, alcohol abuse, chronic illness, and continuous pain,

as well as depression and anxiety in 2000 associated with SPs. When controlling for these factors, also ACEs associated with SPs in all participants and in males and females separately ([Table 4](#)). Adding depression and anxiety into the model clearly decreased the effect of ACEs, indicating that the effect of ACEs was partly mediated through depression and anxiety. Among the ACE factor dimensions, Social disadvantage associated with SPs in males; even when depression and anxiety were included into the model. In females, Family conflicts, Social disadvantage and Maternal mental health problems associated with SPs. After entering depression and anxiety into the model, Social disadvantage no longer showed a significant association, and the effects of Family conflicts and Maternal mental health problems were considerably reduced in females. When also depression and anxiety in 2011

were included into model, the association of ACEs and Social disadvantage remained significant in males but not in females (Table 4, Supplementary Table 5).

In sensitivity analyses, crosstabulation of SPs2000 and SPs2011 showed that 101 participants reported at least considerable SPs in both assessments, thereby indicating chronic sleep problems. These participants were compared with those who reported no SPs in either SPs2000 or SPs2011 ($n = 2762$). In logistic regression analyses, chronic SPs were associated with ACEs and their dimensions in both overall sample and specifically in females. For males, chronic SPs were associated with ACEs and Social disadvantage (Supplementary Table 6). These results suggest that SPs variables indicate long-term sleep problems. Specifically, in males, the association of ACEs on SPs was predominantly associated with Social disadvantage. In females, however, sleep in adulthood was disturbed not only by Social disadvantage but also by an emotionally distressing family atmosphere.

Path analysis for SPs in 2011 confirmed the finding that, in males ACEs had both direct (62 %) and indirect (38 %) effects on SPs, while in females, a great majority of ACEs' effect on SPs was mediated via depression and anxiety (74 %) (Supplementary Table 7). Because it is possible that the direction of the associations between emotional symptoms and SPs is bidirectional [38], our analysis first estimated the effect of ACEs on depression in 2011, taking into account SPs2000 and SPs2011 (Supplementary Table 8a). Subsequently, we assessed the effect of ACEs on SPs2011, with depression in 2000 and 2011 serving as mediators (Supplementary Table 8b). For depression 2011, indirect effect via SPs2000 and SPs2011 was 28.85 % in males and 18.75 % in females. Corresponding figures for SPs2011 were 41.38 % in males and 69.77 % in females, indicating that the indirect effect of ACEs via depression was stronger than the indirect effect on depression via SPs.

4. Discussion

First, we were able to confirm that the ACEs associate with SPs in a prospective population-based setting. Secondly, the associations between the ACE dimensions and SPs differed between males and females. Thirdly, in females, a great majority of ACEs' effect on adult SPs were mediated through affective disturbances, depression, and anxiety or anxiety alone.

In the present study, only 6.8–8.6 % of participants reported at least considerable SPs, a figure that is lower than those reported in previous studies [22,25,26,30]. Different definitions of SPs may explain these differences. However, in all these studies, no significant sex differences were found in differently defined SPs. In line with previous studies [22, 25], there was a dose-dependent association between multiple ACEs and SPs, i.e., the more ACEs the more severe SPs. However, among participants with more than 4 ACEs, the severity of SPs increased suddenly, indicating that a greater number (5+/11) of ACEs disproportionately disturbs sleep. The association between ACEs on SPs remained significant even after taking into account the effects of sex, age, self-reported health, alcohol abuse, chronic illness, and continuous pain. Consistent with previous studies [20,22,25], these factors were also associated with SPs. Sensitivity analyses suggested that a high number of ACEs anticipated long-term chronic SPs.

As observed in previous studies [19,21–23], depression and anxiety at baseline and eleven years later associated with SPs. A new finding was that these affective symptoms acted as mediators between ACEs and SPs. In the predictive model for SPs2011, depression and anxiety mediated 38 % of the effect of ACEs on SPs in males and 74 % in females. The proportion of the direct effect between ACEs and SPs was statistically significant in males (62 %) but minor (26 %) and not significant in females. All these findings indicate that the route from ACEs to SPs in females predominantly occurs via current affective disturbances. In contrast, in males, ACEs directly associate with SPs in adulthood, independently of these symptoms. Theoretically, the reverse direction of effects possible. The path analyses concerning depression in 2011 with

SPs in the same year showed that the mediating effect via depression was stronger, particularly in females, than that via SPs. This indicates that affective disturbances act as mediators for the effect of ACEs on SPs.

Moreover, depression and anxiety symptoms, constantly associating with ACEs, are common comorbidities with several mental and physical disturbances that associate with ACEs. Thus, it is possible that in previous studies, the associations between ACEs and target factors, such as mental disorders and physical illnesses, may be explained by affective comorbid with these target factors. In future studies, the role of depression and anxiety as mediators should be considered.

Factor analysis of ACEs, reducing the number of ACEs, yielded three factor dimensions: Social disadvantage, Family conflicts and Maternal mental health problems. Social disadvantage was mainly composed of childhood family's financial difficulties, parents' unemployment and diseases, indicating socio-economical family problems. Interestingly, also participant's chronic illness and being bullied at school were loaded on the same dimension, emphasising comprehensiveness of this adversity dimension. Therefore, it was understandable that the effects of Social disadvantage on SPs appeared to act similarly to the total number of ACEs, affecting both males and females similarly.

Social disadvantage associated with SPs. In line with our finding, childhood poverty which closely relates to childhood social disadvantage, was associated with experiences of insomnia [30]. However, there was an important sex difference in the effect of Social disadvantage on SPs: in females, the association between Social disadvantage, as well as ACEs and SPs, was entirely mediated through current affective symptoms but not in males. One can speculate that the factors like the parents' good health and stable earnings, enabling and exemplifying family's socioeconomic prosperity, are important particularly for the development of personality and self-confidence in growing boys. Childhood family's socioeconomic problems, uncertain livelihood and parents' ill-health, may violate strength of growing boys' personality and positive attitude to the future, decrease their self-confidence and coping ability and increase their personal feeling of an underprivileged destiny. When faced life's challenges, they may respond with feelings of uncertainty and SPs, even in the absence of current affective symptoms. In comparable situations, females who experienced social disadvantage in their childhood tend to react with affective symptoms, such as depression and anxiety, which are often accompanied by SPs. In males, responses appear to be more influenced by attitudinal or characterological factors, whereas in females, psychological and emotional mechanisms appear to mediate the effects of ACEs.

Childhood poverty is associated with brain development and academic achievement [39]. Our psychosocial findings correspond interestingly with sex differences in neurofunctional reactions. Among healthy adult participants, amygdala reactivity to implicitly processed fearful faces positively correlated with childhood poverty (income-to-need ratio) in adult females, but not in males. On the other hand, activation in dorsolateral and ventrolateral prefrontal regions during emotion regulation by reappraisal was positively correlated with childhood poverty in males. This indicates that childhood poverty is associated with hypersensitive emotional reactivity of the amygdala in females and impaired emotion regulatory function in the prefrontal cortex in males [40]. In contrast to childhood income, concurrent adult income was not associated with neural activity during emotion regulation [41].

Family conflicts and Maternal mental health problems further emphasise differences between males and females. Both Family conflicts and Maternal mental health problems did not associate with SPs in males, but strongly in females. Young girls may have a closer relationship with their mother, and consequently may become more aware of or feel more deeply affected by their mother's mental health problems compared to their brothers. Studies have shown that females tend to exhibit greater interpersonal care and responsibility than males in early interactions with their mother [42], and girls more often act to alleviate maternal distress and to maintain or restore relational harmony [43].

When young girls have more intimate relationship with their mothers than their brothers, they may become more sensitised by emotional stress related to family conflicts and maternal mental health problems. Furthermore, it is possible that childhood family related emotional stress hypersensitises growing girls' amygdala and precipitates their adult emotional reactions and SPs. Like in Social disadvantage, the associations between Family conflicts and Maternal mental health problems became in females insignificant when the effects of affective symptoms were taken into account. This indicates that the effects of these adversities were also mediated via affective symptoms.

4.1. Advantages and limitations

The Health 2000 data encompasses Finnish individuals aged 30 or older. In this study, participants older than 64 years were excluded, meaning our study participants primarily represent the working-age population. The prospective design and the large number of participants stand out as clear advantages of this study. The observation that females reported more family conflicts and maternal mental problems indicate potential sex biases in observation, recall, or reporting. The ACE items focus on objective events, which typically show a weaker association with outcome factors than subjective experiences. This aspect could be viewed as a limitation or an advantage, depending on the perspective. A catalogue of objective events might yield more reliable data than subjective, self-reported questionnaires of childhood experiences [44]. However, our study did not cover all aspects of ACEs, such as childhood maltreatment, including emotional, physical, or sexual abuse, or emotional neglect and childhood trauma [45], potentially diminishing the comprehensiveness of our findings on the effect of ACEs on SPs. Additionally, the duration of ACEs was not available, limiting our ability to assess their long-term effects.

4.2. Clinical implications and future research

In treatment of long-term SPs, it is important to pay attention on patients' childhood adverse and trauma experiences. Psycho- and trauma-therapeutic interventions may increase patients' understanding to and acceptance of their painful childhood experiences and alleviate sleep-disturbing psychological symptoms such as depression and anxiety, and free mental energy for productive functioning. In females, childhood family conflicts may particularly require a psychotherapeutic approach, whereas in males, therapeutic support for self-confidence, especially in case of social disadvantage, may alleviate acceptance of disadvantageous childhood circumstances and reduce sleep-disturbing bitterness. In addition to psychotherapeutic approaches, antianxiety and antidepressant medication may directly target symptoms and be preferable to sleeping pills.

The present study was focused on associations between a number of objective ACEs and self-reported SPs. Further research is needed for a closer characterisation of the various ACEs associating most strongly with adult SPs. An important question concerns the interaction between individuals' personality, ACEs, and adult SPs and psychological and biological mechanisms between ACEs and SPs. Furthermore, the interaction of genetic factors, ACEs, and adult SPs needs to be investigated. E. g., social disadvantage, a central ACE dimension, may include both genetic and social components with different effects on long-term SPs.

5. Conclusions

In a prospective, population-based setting, we studied the effects of ACEs on SPs among working-aged adults, using repeated measures ANOVA and path analyses. We found that multiple ACEs associated with SPs in adulthood even after controlling confounding factors, sex, age, marital status, education, income, smoking, alcohol abuse, chronic illness, and continuous pain. Of the ACE dimensions, Social disadvantage associated with SPs in males and females, while the association

between ACEs and SPs was mediated by affective symptoms, depression and anxiety, in females but not in males. Family conflicts and Maternal mental health problems associated with SPs in females only. This association was mediated by affective symptoms such as depression and anxiety. In treating long-term SPs, it is important to investigate patients' childhood living conditions and emotional atmosphere of their family, including how these were perceived by the patient. Understanding both the direct effects and the indirect effects via affective disturbances on long-term SPs is essential. Childhood psychological distress requires attention particularly in females.

CRedit authorship contribution statement

Raimo K.R. Salokangas: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Tiina From:** Writing – review & editing, Writing – original draft, Software, Project administration, Data curation. **Henri R.W. Salokangas:** Writing – review & editing, Writing – original draft, Methodology. **Lara Lehtoranta:** Writing – review & editing. **Seppo Koskinen:** Writing – review & editing, Resources, Project administration. **Jarmo Hietala:** Writing – review & editing, Writing – original draft, Supervision.

Ethical standards

The study has approval of the Ethics Committee of the Hospital District of Helsinki and Uusimaa. Participants provided written informed consent.

Availability of data

Data is not available due to ethical and legal restrictions.

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Declaration of competing interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.sleep.2025.01.035>.

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