

Adverse childhood experiences (ACEs) and substance use disorder (SUD): A scoping review

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ABSTRACT

Background: The long-term negative effects of adverse childhood experiences (ACEs) and their impact on physical and mental health has been widely studied. However, research about the relationship between ACEs and substance use disorder (SUD) diagnosis in adolescence and adulthood is still scarce. Therefore, this scoping review was conducted to collect the existing research findings to explore the relationship between the experience of ACEs and the diagnosis of SUD later in life.

Methods: The PsycINFO, Medline, Scopus, Web of Science, and Cochrane Library databases were searched. After identifying the records based on eligibility and exclusion criteria, 12 studies were finally selected for inclusion.

Results: Most of the studies were conducted in the USA with adult male and female participants. All studies were cross-sectional in nature and assessed ACEs retrospectively. The main conclusions of the studies were that there is a higher prevalence of ACEs in the population with SUD than in the general population, and a positive association between ACEs and the development and severity of SUD in adolescence and adulthood.

Conclusions: It is difficult to make comparisons between studies and to draw solid conclusions because of the lack of standardized criteria for evaluating ACEs and due to the heterogeneity in the substance types examined. More research is needed to fully elucidate the underlying mechanism of the relationship between ACEs and SUD.

1. Introduction

Substance use problems are prevalent and widespread throughout the world and are associated with multiple short- and long-term health risks as well as with substantial personal, societal, and economic costs (Bouchery et al., 2011). Some individuals are more susceptible to developing an addiction problem than others due to several risk factors. Some of these risk factors are related to certain personality characteristics (e.g., impulsivity, behavioral disinhibition, sensation seeking) (Cox et al., 2015; Jentsch et al., 2014), psychiatric disorders (e.g., attention-deficit/hyperactivity disorder, anxiety disorders) (Ducci and Goldman, 2012), the vulnerability of adolescence (Torregrossa et al., 2011), social contexts (e.g., peer influence, social acceptance or availability of the substance) (Cox et al., 2015; Shmulewitz et al., 2015), or family environments (e.g., living with someone who abuses alcohol or drugs, having abusive or neglectful parents) (Vink, 2016).

In recent years, childhood-related factors have increasingly been analyzed with the aim of understanding how the trajectories of substance abuse and dependence begin. Specifically, there has been a

growing interest in the role of adverse childhood experiences (ACEs) (Fuller-Thomson et al., 2016), which have been described as potentially traumatic events that can have negative long-term effects on health and well-being (Boullier and Blair, 2018). In 1998, Felitti et al. first described ACEs and defined them as exposure to psychological, physical or contact sexual abuse and household dysfunction, including substance abuse (drug or alcohol) by a household member, having a household member with mental illness, witnessing a mother or stepmother being treated violently, and criminal behavior in the household during the first 18 years of life. Other studies have also included emotional and physical neglect (Dube et al., 2003), parental separation (Dube et al., 2002), loss of family members or friends, long-term financial adversity (Mersky et al., 2013), bullying (Kiburi et al., 2018), community violence, and collective violence or war (Cronholm et al., 2015; Naal et al., 2018).

Regarding the prevalence of ACEs in the general population, a study with 214,157 US adults found that more than half of the respondents (61.55 %) experienced at least one ACE (Merrick et al., 2018). In studies carried out in other countries, the prevalence of ACEs ranges from 46.2%–66.2% in the adult population (Chang et al., 2019; Hughes et al.,

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2019) and from 75 % to 85 % in the adolescent population (Affi et al., 2020; Soares et al., 2016). These percentages indicate the high prevalence of ACEs among adult and adolescent general populations across different countries and cultures. ACEs are important to examine not only due to their high prevalence but also because these experiences have an impact on the development and health of those who have experienced them (Ford et al., 2014; Hughes et al., 2017). ACEs affect emotion regulation, causing an inability to modulate distressing emotions in a healthy and adaptive way (Cloitre et al., 2009). Therefore, substance use could be an attempt to cope with these and alleviate these emotions (Chandler et al., 2018; Ducci and Goldman, 2012), which in turn could explain the relationship between ACEs and SUD. Thus, having a history of ACEs might increase the risk of developing SUD (Buckingham and Daniolos, 2013; Dube et al., 2002; Khoury et al., 2010; Wendland et al., 2017). In fact, people in treatment for an addiction have a higher prevalence of ACEs than the general population. Among patients with addiction problems, the rates of having suffered at least one ACE ranges from 85.4%–100% (Chandler et al., 2018; Philogene-Khalid et al., 2020; Stein et al., 2017). Moreover, various studies have found that this risk has a cumulative effect; as the number of ACEs increases, the risk for SUD during life also increases (Dube et al., 2003; LeTendre and Reed, 2017).

As ACEs may be a predisposing factor for the development of addictions in adulthood (Keyes et al., 2014), the main goals of this scoping review were to provide a summary of research findings from recent literature on the relationship between ACEs and SUD, to identify gaps in knowledge, and to propose specific avenues for future research. This review aims to advance the understanding of the link between having a history of ACEs and the later development of an SUD. Therefore, the research question guiding this scoping review is as follows: What is known from the existing literature about the association between ACEs and SUD?

2. Method

In this study, the scoping review methodology proposed by Arksey and O'Malley (2005) and Levac et al. (2010) was used. This framework outline includes five stages: (1) identifying the research question; (2) identifying relevant studies; (3) selecting studies; (4) charting the data; and (5) collating, summarizing, and reporting the results. Moreover, to adjust the methodology to the guidelines for conducting and publishing scoping reviews, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) was used, and a 22-item checklist to follow the recommendations in each phase of the process was considered (Tricco et al., 2018).

2.1. Protocol and registration

The protocol of this scoping review was registered on the Open Science Framework (OSF; <https://osf.io/wfycs>) prior to searching for relevant studies.

2.2. Eligibility criteria

Four eligibility criteria were established to focus the bibliographic search and to limit the extension of the results: (a) publications in English language; (b) peer-reviewed scientific articles; (c) quantitative research; and (d) articles published between 1990 and 2020. The rationale for these criteria was that English is the main scientific language and that peer-reviewed journals offer a higher guarantee of quality in the selected studies. Moreover, due to the lack of previous scoping reviews on this topic, the last 30 years were included for analysis. The main studies about ACEs were published for the first time in the late 1990s (Felitti et al., 1998); therefore, the possibility of peer review studies meeting the eligibility criteria published prior to 1990 was unlikely. All the studies selected after considering these eligibility criteria

were examined in detail for the subsequent analysis, comparison, and interpretation.

2.3. Search strategy and information sources

The following bibliographic databases were included in the study for the literature search: PsycINFO, MEDLINE, Scopus, Web of Science (WoS), and Cochrane Library. The research strategy included key words related to ACEs and SUD combined with the Boolean operators AND and OR. After determine the combination of words that was better suited for the research, the final and decisive search was conducted on 2 July 2020. The search strategy and the systematic search of the literature were developed with the help of an experienced information technician along with input from the project team. The full electronic search strategy for the five databases used in this study is presented in Table 1.

2.4. Study selection and data abstraction

After removing duplicates, two levels of screening for the study selection were established, following the same procedure as Zechen et al. (2019). At level 1 of screening, two independent reviewers of the research team reviewed the titles and abstracts of all the papers obtained from the electronic database search. At level 2 of screening, the full texts of the papers were reviewed. This second level was implemented in cases in which there was not enough information to make an informed decision solely based on a title or abstract. Interrater reliability for the 123 results obtained in level 1 of screening and the six results in level 2 of screening was calculated by Cohen's kappa. Discrepancies between reviewers were resolved by discussions between reviewers until a consensus was reached.

Two criteria were used for the final selection of the studies: (a) the use of the concept of ACE, and (b) the diagnosis of an SUD. First, only the studies that employed the ACE concept were selected, excluding all the studies that assessed maltreatment or abuse without using this term. Second, the included articles had to diagnose an SUD (specifying the diagnosis criteria and/or measurement to assess it) and/or to carry out the study recruiting a sample from an addiction treatment program

Table 1
Search Strategy in all Databases.

Web of Science search words		Results
#3	#1 AND #2	45
#2	TI= ("substance use" OR "substance abuse" OR "substance misuse" OR "drug" OR "addiction" OR "addict")	427,280
#1	TI= ("adverse childhood experiences" OR "aces")	1481
PsycINFO search words		Results
#1	TI (adverse childhood experiences or aces) AND TI (substance use or substance abuse or substance misuse or drug or addiction or addict)	36
Medline search words		Results
#3	#1 AND #2	24
#2	TI= ("substance use" OR "substance abuse" OR "substance misuse" OR "drug" OR "addiction" OR "addict")	157,709
#1	TI= ("adverse childhood experiences" OR "aces")	714
Scopus search words		Results
#3	#1 AND #2	116
#2	(TITLE("substance use" OR "substance abuse" OR "substance misuse" OR "drug" OR "addiction" OR "addict")AND DOCTYPE (ar) AND PUBYEAR > 1990 AND PUBYEAR < 2020)	279,532
#1	(TITLE("adverse childhood experiences" OR "aces") AND DOCTYPE (ar) AND PUBYEAR > 1990 AND PUBYEAR < 2020)	7220
Cochrane Library search words		Results
#1	TI (adverse childhood experiences or aces) AND TI (substance use or substance abuse or substance misuse or drug or addiction or addict)	16

(which assumes the presence of a diagnosis).

Eligible study designs included randomized controlled trials, observational studies (cohort, cross-sectional, case-control), descriptive, and mixed methods studies. Extracted data included the authors, year of publication, sample size, age, study setting, percentage of male/female participants, types of ACEs (e.g., psychological, physical, sexual abuse), ACE measurement instrument (if used), diagnosis of SUD (both general and specific SUD), and main findings.

As carried out by Bunn et al. (2014), in the protocol, it was planned that whether the results of a study were reported in more than one publication, the articles would be combined, and the publication would be classified with the most complete data as the primary reference. The other publications describing the same study would be classified as associated papers. However, there were no studies that met this criterion.

3. Results

3.1. Study selection

Fig. 1 presents the flow diagram of the study selection. A total of 237 studies were identified through the database searches. After removing duplicates, 123 records remained. Of these, 90 were excluded, and 33 were selected for full-text review. After the full-text review, 21 studies were excluded (two due to the lack of information on the relationship between ACEs and SUD and 19 because of the absence of a clinical

diagnosis of SUD). Twelve studies were finally eligible for inclusion. The interrater reliability (Cohen’s kappa statistic) for level 1 of screening was 0.98, and that for level 2 of screening was 1.00.

3.2. Characteristics of the included studies

Most of the studies were carried out in the United States (66.7 %; $n = 8$), followed by Asia (16.7 %; $n = 2$), Canada (8.3 %; $n = 1$), and Africa (8.3 %; $n = 1$) (Table 2). All of the studies were cross-sectional and retrospectively assessed ACE. The majority of the studies included both men and women (83.3 %; $n = 10$); two studies (16.7 %) included only men, and none of them included only women. One study (8.3 %) was carried out with an adolescent population, and the rest were conducted with adult participants (91.7 %; $n = 11$).

The sample sizes ranged from 30 to 21,554 participants, with ages ranging from 15 to 85 years. Two studies did not offer the rate of male and female participants. Of those eight studies that included both men and women, five had a higher percentage of female participants (Table 3).

3.3. Adverse childhood experiences (ACEs)

Four studies assessed 10 types of ACEs [2, 4–6]. A smaller number of ACEs (3, 6, 8 or 9) was employed in some studies [1, 3, 8, 11, 12], and in other cases, this number was increased (from 11 to 13 ACEs) [7, 9, 10]. Those who used different types of ACEs than the original study (Felitti

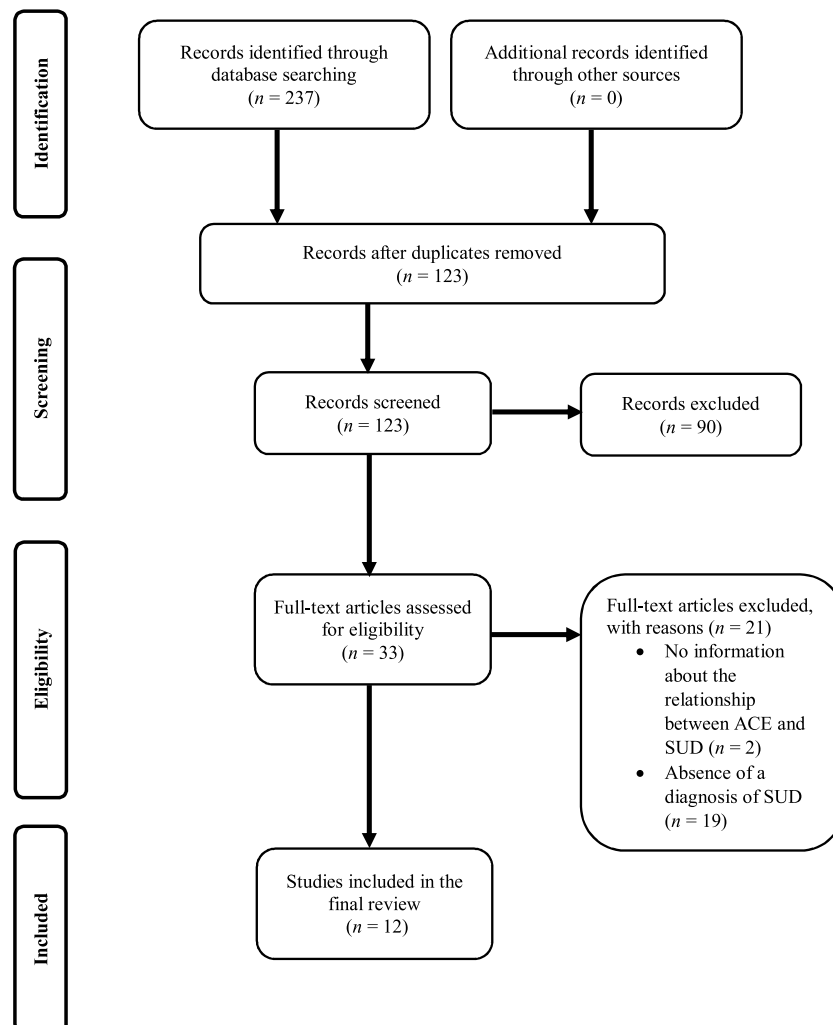


Fig. 1. Flow Diagram.

Table 2
Characteristics of Included Studies (N = 12).

Characteristics	Number of studies (%)
Place	
USA	8 (66.7)
Asia	2 (16.7)
Canada	1 (8.3)
Africa	1 (8.3)
Type of study	
Cross-sectional	12 (100)
Retrospective assessment of ACEs	12 (100)
Sample type	
General population	6 (50)
Specific population	6 (50)
Patients in addiction treatment programmes	5
Males in sexual offender treatment programmes	1
Sex	
Men	2 (16.7)
Women	0
Both	10 (83.3)
Sample	
Adult (≥ 18 years)	11 (91.7)
Youth (< 18 years)	1 (8.3)
Both	0

et al., 1998) added experiences such as bullying, community violence, collective violence/war, economic adversity, property victimization, or exposure to gang violence [7–10].

The assessment of ACEs was made using different measures (Table 3). Two studies used the original 10-item ACE scale (Centers for Disease Control and Prevention, 2013) [2, 4]; three studies employed other versions, such as some adaptations of the CDC-Kaiser ACEs Study (Anda et al., 2006; Ruan et al., 2008) [10–12]; and two studies used the Adverse Childhood Experiences International Questionnaire (ACE-IQ) (World Health Organization, 2011) [7, 8]. The rest of the studies employed or added different structured questionnaires to assess specific types of ACEs: the Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 1994; Fink et al., 1995) [9, 11], Positive and Adverse Childhood Events Survey (PACES) (Leitch, 2015) [5], Childhood Experiences of Violence Questionnaire-Short Form (Tanaka et al., 2012) [1], Conflict Tactics Scale (CTS) (Straus, 1979) [11], Childhood Sexual Abuse Questionnaire (Wyatt, 1985) [11], Verbal Aggression Scale (VAS) (Teicher et al., 2006; Tomoda et al., 2011) [9], and additional *ad hoc* questions [1, 3, 6, 9].

3.4. Substance use disorder (SUD)

Different measures were used to assess SUD. Three studies did not specify the diagnosis criteria [4, 5, 7], one study designed specific questions to reflect the diagnostic criteria of the DSM-IV (American Psychiatric Association, 1994) [3], one was based on the DSM-IV-TR (American Psychiatric Association, 2000) criteria [6], and two on the DSM-5 (American Psychiatric Association, 2013) criteria [8, 12]. Additionally, four studies employed specific assessment instruments, such as the World Health Organization-Composite International Diagnostic Interview (WHO-CIDI) (Kessler et al., 1998; World Health Organization, 1990) [1, 9], the Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS) (Grant et al., 2015) [10, 11], and the Rutgers Alcohol Problem Index (RAPI) (White and Labouvie, 1989) [9]. The last study elaborated 11 questions *ad hoc* for the research [2].

3.5. Association between ACEs and SUD

The 12 studies revealed either a positive association between the presence of ACEs and an SUD diagnosis or a higher prevalence of ACEs among people in treatment for SUD than in the general population. The main results organized by the sample type are briefly reported below.

3.5.1. General population

Fuller-Thomson et al. (2016) [1] collected the largest sample of individuals from the general population. A significantly higher proportion of the participants with SUD reported a history of the three assessed ACEs than those without SUD. Each ACE was significantly associated with drug and alcohol dependence, with the relationships independent of each other type of ACE. For those who experienced sexual abuse and physical abuse, the odds for drug dependence were larger than for those who experienced alcohol dependence, but for those who witnessed domestic violence, the odds were higher for alcohol dependence than for drug dependence. No differences in ACEs were found between men and women. The authors concluded that the three ACEs were significantly associated with both alcohol and drug dependence in adulthood. Additionally, they suggested that drug dependence was more strongly associated with the more invasive forms of direct violence and that the effect of chronic exposure to parental domestic violence appeared to increase the odds of substance dependence even if no direct form of childhood abuse was experienced.

LeTendre and Reed (2017) [3] carried out a secondary analysis from a national longitudinal study. The majority of the participants (79.8 %) reported zero ACEs, 13.1 % reported one ACE, 6.1 % reported two ACEs, and 1% reported all three types of assessed ACEs. Lifetime history of AUD was present in 27.7 % of the participants; cannabis use disorder (CUD) was present in 12.7 % of participants, and drug use disorder (DUD) was present in 7.5 % of participants. The results showed that each increase in the number of ACEs was associated with 34 % higher odds of developing AUD, 47 % higher odds of developing CUD, and 41 % higher odds of developing DUD in adulthood. The authors established a positive relationship between ACEs and any SUD in adulthood.

Shin et al. (2018) [9] carried out a latent class analysis (LCA), which identified a 4-class model of ACEs: Low ACE (56 %), Household Dysfunction/Community Violence (14 %), Emotional ACE (14 %), and High/Multiple ACE (16 %). They found that, compared to the Low ACE class, the High/Multiple ACE class was significantly associated with increased alcohol-related problems. However, none of the ACE classes was significantly associated with the number of drug dependence symptoms. Additionally, compared to the Household Dysfunction/Community Violence class, the High/Multiple ACE class was related to higher levels of alcohol-related problems. The High/Multiple ACE class had significantly higher levels of alcohol-related problems than the Emotional ACE class. The authors concluded that young adults exposed to multiple ACEs were at higher risk for alcohol-related problems.

In the study of Kim et al. (2019) [10], 17 % of the participants presented with an SUD. The authors carried out an LCA to identify patterns of ACE exposure and identified four classes: High Adversity (6%), Low Adversity (69 %), Child Abuse (16 %), and Parental Substance Use (8%). The High Adversity class was more likely to be diagnosed with SUD in the past year than the Low Adversity class. The Child Abuse class reported a significantly higher likelihood of SUD than the Low Adversity class. Finally, the Parental Substance Use class showed significantly higher odds of SUD than the Low Adversity class. The conclusion was that some ACE classes were associated with mental health and, in turn, with SUD risks in later adulthood.

In the study of Rhee et al. (2019) [11], the presence of almost one ACE was reported by 35.9 % of the participants. More precisely, in these participants, 57.5 % reported one ACE, 24.6 % reported two ACEs, and 18 % reported three or more ACEs. The most prevalent ACE was parental psychopathology (20.3 %), followed by other traumatic events (14 %) and physical or psychological abuse (8.4 %). The results showed that having experienced any ACEs was positively associated with past-year SUD, AUD, and tobacco use disorder (TUD) diagnosis.

Moss et al. (2020) [12] used secondary data from a longitudinal study. The prevalence of each ACE was lower among the participants who raised in a typical home compared to those who experienced foster care or homelessness. Those who experienced three ACEs (OR = 1.69) or four or more ACEs (OR = 1.94) had an increased risk for moderate AUD

Table 3
Characteristics of the Studies Included in the Final Review.

No.	Authors and year	Sample size Sample type Age	Males and females (%)	Number of ACE Type Measure	SUD diagnosis Measure	Main findings
1	Fuller-Thomson et al., 2016	N = 21,554 General population adults	–	3 ACE PA, SA, WDV Childhood Experiences of Violence Questionnaire-Short Form for PA and SA A question <i>ad hoc</i> for WDV	Alcohol and drugs (marijuana, hashish, prescription drugs) Questions based on the World Health Organization-Composite International Diagnostic Interview (WHO-CIDI)	Each ACE is significantly associated with drug and alcohol dependence across all the models tested.
2	Levenson, 2016	N = 679 Adult sex offenders	M: 100 %	10 ACE EA, PA, SA, EN, PN, WDV, PS, PSA, PMI, HMI	Alcohol, marijuana, prescription drugs, tobacco, and other illegal drugs	ACE scores significantly correlated with substance abuse scores. The only single ACE that significantly correlated with elevated substance abuse was PSA. As ACE scores increased by one point, the likelihood of alcohol abuse in adulthood increased by 29 %, illegal drug abuse by 24 %, marijuana abuse by 22 %, and smoking cigarettes by 14 %.
3	LeTendre and Reed, 2017	N = 11,279 General population adults M = 28.92 years	M: 48.7 % F: 51.3 %	3 ACE EA, PA, SA 3 questions from the Add Health Survey	Alcohol, cannabis, and other drugs Diagnostic criteria of DSM-IV	Each one-unit increase in the ACEs scale was associated with 34 % higher odds of developing an AUD in adulthood, with 47 % higher odds of developing a CUD, and 41 % higher odds of developing a DUD. There was a positive relationship between ACEs and substance abuse.
4	Stein et al., 2017	N = 457 Adults seeking inpatient opioid detoxification 18 – 64 years	M: 71.3 % F: 28.7 %	10 ACE EA, PA, SA, EN, PN, WDV, PS, PSA, PMI, HMI 10-item ACE Scale	Opioids Not specified	Mean score of ACEs was 3.64. 36.8 % had between 1 and 3 ACEs and 48.6 % reported 4 or more ACE. The ACE score was inversely associated with age of opioid use initiation, and positively associated with the likelihood of a recent IDU, and with the expected odds of a lifetime overdose. ACEs are associated with each opioid-related behavioural marker in a graded manner.
5	Chandler et al., 2018	N = 30 Clients of a SUD treatment in an outpatient setting 21 – 70 years	M: 36.7 % F: 63.3 %	10 ACE EA, PA, SA, EN, PN, PS, WDV, PSA, PMI, HMI Positive and Adverse Childhood Events Survey (PACES)	Alcohol and drugs Not specified	All participants reported at least one ACE and 82.8 % reported more than four ACE. The mean number of ACEs in the sample was 5.8.
6	Gomez et al., 2018	N = 260 Adolescents at an addiction treatment centre M = 15.5 years	M: 81.2 % F: 18.8 %	10 ACE EA, PA, SA, N, PS, WDV, PSA, HMI, PMI, OH Adolescent self-report, parent/legal guardian report, and/or hospital record of reported child abuse and neglect	Alcohol and drugs (cannabis, heroin, methamphetamine, barbiturates, cocaine, glue and solvents, LSD, ecstasy and other hallucinogens, stimulants, tranquilizers, and synthetic drugs) Clinical interview with DSM-IV-TR criteria	Exposure to household dysfunction was associated with a 2-fold increased risk of SUD, but exposure to abuse was not significantly associated. Having 2 ACEs was associated with more than 2-fold increased risk of SUD. Having ≥ 3 ACEs had a 7-fold increased risk of SUD. Number of ACEs was positively associated with the severity of recent drug use and negatively associated with age of drug initiation.
7	Kiburi et al., 2018	N = 134 Adult patients with SUD in a psychiatric hospital 18 – >40 years	M: 88.1 % F: 11.9 %	12 ACE PA, EA, SA, PN, EN, WDV, PSA, PMI, HMI, B, CV, COV	Alcohol, tobacco, cannabis, cocaine, amphetamine, inhalants, sedatives, hallucinogen, opioids and khat	EA was a significant predictor of using tobacco. WDV increased the risk of lifetime alcohol use. Lifetime sedative use positively associated with PA, EA and PMI.

(continued on next page)

Table 3 (continued)

No.	Authors and year	Sample size Sample type Age	Males and females (%)	Number of ACE Type Measure	SUD diagnosis Measure	Main findings
8	Naal et al., 2018	N = 144 Adults in an addiction centre 18 – 69 years N = 336 General population adults	M: 100 % M: 48.5 %	Adverse Childhood Experiences International Questionnaire (ACE-IQ) 8 ACE M, RP, N, FE, PA-EA-SA, B, CV, COV ACE-IQ 13 ACE SA, PA, EA, PN, EN, WDV, PSA (alcohol), PSA (drug), PMI, HMI, VO, PC, GV	Not specified Opioids, cocaine, cannabis and alcohol Diagnostic criteria of DSM-5 Alcohol, tobacco and other drugs The Rutgers Alcohol Problem Index (RAPI)	Cannabis, tobacco, and sedatives were the only substances with significant positive correlation with ACEs. A total of 98.1 % of participants reported having experienced at least 1 ACE, while 74.3 % reported experiencing 6 or more ACEs. More than half of the sample (57.3 %) reported first using illicit substances before the age of 18. ACEs are prevalent in SUD patients. The High/Multiple ACEs group was significantly associated with increased alcohol-related problems and with tobacco use in young adulthood compared to the Low ACE group. None of the groups was significantly associated with the number of drug dependence symptoms.
9	Shin et al., 2018	18 – 25 years N = 11,386 General population adults	F: 51.5 % M: 46 %	The Childhood Trauma Questionnaire (CTQ) for EA, PA, SA, EN and PN Verbal Aggression Scale (VAS) for VO Questions <i>ad hoc</i> for the rest of the variables 11 ACE PA, EA, SA, PN, EN, WDV, Eca, PSA, HMI, PMI, SAC	Project-developed questionnaire for tobacco WHO-CIDI for substance use Alcohol, tobacco, cannabis, and other drugs (sedative, opioid, cocaine, stimulant, hallucinogen, inhalant, solvent, club drug, heroin)	Different patterns of exposure to ACEs may be associated with specific substance use outcomes. The high adversity group was more likely to have a SUD in the past year compared to Low adversity group. The child abuse group reported significantly higher likelihood of SUD than Low adversity group. The parental substance use group had significantly higher odds of SUD than Low adversity group. Early adversities are associated with SUD risk in later adulthood, although only for some ACE classes. Having experienced any ACEs was positively associated with past-year SUD.
10	Kim et al., 2019	≥ 55 years N = 5806 General population adults	F: 54 % M: 44.2 %	10 indicators adapted from the CDC- Kaiser ACE Study 6 ACE N, PA or EA, SA, WDV, PMI, OTE	The Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS) to assess DSM-5 criteria Alcohol, tobacco, and other illicit d rugs (sedatives, cannabis, opioid, cocaine, stimulant, hallucinogen, heroin, inhalant/solvent, club drug)	Having experienced ACEs was associated with a higher likelihood of a past-year AUD and TUD diagnosis.
11	Rhee et al., 2019	≥ 65 years N = 9421 General population adults	F: 55.8 % M: 44.2 %	CTQ, Conflict Tactics Scale (CTS), Childhood Sexual Abuse Questionnaire and CDC-Kaiser ACE study 9 ACE EA, PA, SA, PSA, PMI, PS, HMI, EN, PN	AUDADIS to assess DSM-5 criteria Alcohol, tobacco and cannabis Diagnostic criteria of DSM-5	The experience of homelessness in addition to ACEs were significantly associated with the development of the most severe forms of AUD and TUD, and all severity levels of CUD in young adulthood.
12	Moss et al., 2020	24 – 32 years	M: 46 %	Items derived from the CDC-Kaiser ACE Study	Alcohol, tobacco and cannabis Diagnostic criteria of DSM-5	The experience of homelessness in addition to ACEs were significantly associated with the development of the most severe forms of AUD and TUD, and all severity levels of CUD in young adulthood.

Note. ACEs = adverse childhood experiences: EA = emotional/psychological abuse; PA = physical abuse; SA = sexual abuse; EN = emotional neglect; PN = physical neglect; N = neglect; PS = parental separation/divorce/death; WDV = witnessing domestic violence; PSA = parental/household member substance abuse; PMI = parental/household member mental illness/suicidality; SAC = household member who attempted or committed suicide; HMI = household member incarceration; OH = out-of-home residential care; B = bullying; CV = community violence; COV = collective violence/war; Eca = economic adversity; OTE = other traumatic events; VO = caregiver verbal offense; PC = property crime; GV = gang violence; RP = relationship with parents; M = marriage; FE = family environment; SUD = substance use disorder: AUD = alcohol use disorder; TUD = tobacco use disorder; CUD = cannabis use disorder; DUD = drug use disorder; IDU = injection drug use.

in young adulthood. Severe AUD in young adulthood was strongly associated with the experience of one (OR = 1.63), two (OR = 2.57), three (OR = 2.29), or four or more (OR = 2.92) ACEs. With respect to cannabis, reporting one, two or three ACEs increased the risk for moderate CUD. There was no significant relationship between reporting four or more ACEs and CUD, but the authors argued that this inconsistency might be due to Type II error. Finally, reporting one (OR = 2.60), two (OR = 2.12), three (OR = 3.90) or four or more (OR = 3.94) ACEs significantly increased the risk for severe CUD.

3.5.2. Adolescent population in addiction treatment

In the sample of Gomez et al. (2018) [6], 34.6 % had DUD, and 3.8 % had alcohol use disorder (AUD). The prevalence of at least one ACE was 46.5 %, while 25 % of the participants reported multiple forms of ACEs. The most prevalent ACE was parental separation or divorce (26.9 %), followed by household substance use (24.6 %). Exposure to household dysfunction was associated with a 2-fold increased risk of SUD, but exposure to abuse was not significantly associated with SUD. Moreover, adolescents with two ACEs had a more than 2-fold increased risk of SUD, and those with three or more ACEs had a 7-fold increased risk of SUD compared with those without ACE exposure. They concluded that the number of ACEs was positively associated with the severity of recent drug use and negatively associated with the age of drug initiation.

3.5.3. Specific population

Levenson (2016) [2] assessed a sample of male sexual offenders. Only 15.6 % of them reported zero ACEs, and 45.7 % reported four or more ACEs. The most prevalent ACE was parental separation or divorce (54 %), followed by verbal abuse (53 %), household substance abuse (47 %), physical abuse (42 %), sexual abuse, and emotional neglect (38 % each). In terms of substance use, 44 % had alcohol-related problems, and 33 % reported illicit drug abuse. There was a consistent gradual increase in the mean substance abuse score as more ACEs were reported. The participants who reported four or more ACEs endorsed more than twice the number of substance abuse items than those with zero ACEs. Each increase in the number of ACEs was associated with an increase in the likelihood of seeking voluntary or mandatory treatment for substance abuse. The author concluded that childhood adversity might increase the risk for substance abuse problems in adulthood for male sex offenders.

Stein et al. (2017) [4] evaluated patients in a treatment programme for detoxification. Only 14.7 % reported zero ACEs, 36.8 % reported between one and three ACEs, and 48.6 % had four or more ACEs. The most prevalent ACEs were having separated or divorced parents (59.5 %), living with a problem drinker or someone who used drugs (51.4 %), and having an adult in the household who often swore at or humiliated them (47.5 %). The mean ACE scores for females were significantly higher than those for males. The ACE score was inversely associated with the age of opioid use initiation. Moreover, each increase in the number of ACEs was associated with a 1.11-factor increase in the expected likelihood of recent injection drug use and with a 1.10-factor increase in the expected odds of reporting a lifetime overdose. The authors concluded that ACEs were associated with opioid-related behavioral markers in a graded manner.

Chandler et al. (2018) [5] carried out a descriptive study with clients of an SUD treatment program. All of the participants reported at least one ACE. Of these, 82.8 % reported more than four ACEs, with the majority of them having six or seven ACEs. The most prevalent ACE was having experienced the death, abandonment or divorce of a parent (82.8 %), followed by emotional abuse and witnessing violence at home (75.9 % each). They established that there was a higher number of ACEs in the population with SUD than in the general population.

Kiburi et al. (2018) [7] assessed patients receiving treatment for SUD in a psychiatric hospital. Only 7.5 % reported zero ACEs, while 26.1 % reported six or more ACEs. Having only one or no parent (50 %) was the most prevalent ACE, followed by having a household member treated

violently (49.3 %). Males reported more ACEs than females. The most common substance used was alcohol (82.1 %). The majority of the participants used at least two substances, and only 9.7 % used a single substance. During their lifetime, emotional abuse was a significant predictor of tobacco use; having a household member treated violently increased the risk of alcohol use; and sedative use was positively associated with physical abuse, emotional abuse, and household mental illness. When the current use of substances was assessed, cannabis, tobacco, and sedatives were the only substances positively correlated with ACEs, with no association between the use of alcohol and ACEs.

Naal et al. (2018) [8] conducted research with patients in an addiction center (87.3 % for opioids). The majority of the participants (98.1 %) reported having experienced at least one ACE, and almost all (74.3 %) reported experiencing six or more ACEs. More than half of the sample (57.3 %) reported first using illicit substances before the age of 18. Some of the most common forms of ACEs were seeing someone being beaten up (83.1 %), being in a physical fight (83 %), being yelled at or humiliated by a more powerful household member (63 %), being hit by a more powerful household member (45.5 %) and being forced to leave home due to war-related events (44.8 %). They concluded that ACEs were prevalent in SUD patients.

4. Discussion

To the best of our knowledge, this is the first scoping review addressing the existing evidence about the relationship between the presence of ACEs and the development of an SUD later in life. Taking into consideration the inclusion criteria that were established, only 12 eligible publications have been published since 1990. All of them were published between 2016 and 2020, which means that this is an emerging research focus, and the findings are still inconclusive.

All the studies reported either a positive association between ACEs and a later diagnosis of SUD or a higher prevalence of ACEs among people in treatment for SUD than in the general population. These findings are consistent with research that has supported the relationship between ACEs and further negative health consequences in the general population (Buckingham and Daniolos, 2013; Cicchetti and Handley, 2019; Felitti et al., 1998; Hughes et al., 2017). Four of the included studies have evidenced the cumulative effect of ACEs on the diagnosis of SUD (Gomez et al., 2018; LeTendre and Reed, 2017; Levenson, 2016; Shin et al., 2018), which was already demonstrated in previous research (Dube et al., 2003). Two studies reported a positive relation between the presence of SUD with an earlier onset of substance use (Gomez et al., 2018; Stein et al., 2017).

However, the lack of a unique criterion for assessing ACEs across studies indicates that the results should be interpreted cautiously. The number (between three and 13) and the types of ACEs that have been evaluated in the studies are extremely diverse, which leads to the impossibility of comparing results and obtaining homogeneous conclusions. In this sense, some of the studies have linked specific types of ACEs with an increased risk of SUD (Fuller-Thomson et al., 2016; Gomez et al., 2018; Kiburi et al., 2018; Levenson, 2016). Additionally, Fuller-Thomson et al. (2016) concluded that SUD was more strongly associated with the more invasive forms of direct violence in childhood, such as sexual and physical abuse, than with witnessing domestic violence. However, further research is needed to confirm these associations and to evaluate how and to what degree different forms of ACE, their chronicity, and their severity are related to SUD diagnosis (Cicchetti and Handley, 2019). Moreover, it is necessary to identify possible associations between specific types of ACEs and specific types of substances. The lack of longitudinal studies assessing the relationship between ACEs and SUD is an obstacle to draw stronger conclusions.

The relationship between ACEs and SUD is complex, and several personal and contextual factors should be taken into account to determine which of them mediates this association and its underlying mechanisms. In this regard, only one of the included studies mentioned

protective factors as being relevant for this explanation (Chandler et al., 2018). Research on how protective factors mediate the relationship between experiencing ACEs and its later consequences is still sparse (Moore and Ramirez, 2016). However, these factors should be considered in future research, as encouraging findings have been identified about their mediating effects between ACEs and its long-term negative health outcomes. Recent research has suggested that protective factors moderate the effects of ACEs buffering their negative outcomes (Crouch et al., 2019; Liu et al., 2020; Moore and Ramirez, 2016). The relationship between ACEs and subsequent SUD development might be partially mediated by a coping mechanism or a self-mediation strategy throughout which victims deal with their feelings associated with childhood maltreatment (Huang et al., 2011). This relationship supports the application of trauma-informed care principles in treatments for SUD (Kim et al., 2019), which have shown better treatment retention rates (Amaro et al., 2007).

4.1. Limitations

The limitation of the inclusion criteria to the specific concept of ACEs has restricted the scoping review to those studies that used this term and has overlooked additional research that might have evaluated some specific forms of maltreatment or abuse in relation with SUD without employing the ACEs concept. The same happened with the criteria of SUD diagnosis instead of taking into account a more widely considered substance consumption.

All the included studies had their own limitations. The retrospective design of the 12 studies to self-report ACEs could have underreported these experiences and biased the results of each study and of this scoping review. Additionally, this methodology does not allow us to establish causal inferences between ACEs and SUD. Furthermore, some of the samples might not have been representative due to their restrictive sample size or their recruitment method (e.g., clinical settings and convenience samples). Finally, none of the studies were conducted in a European country, leading to the impossibility of comparing results with this region.

5. Conclusion

This scoping review has summarized the current knowledge about the relationship between ACEs and SUD. Some research gaps have been identified. Research on the contribution of the different forms and severity of ACEs to the development of SUD both in adolescence and in adulthood is limited. Hence, more research is needed in this area. Due to the high prevalence of ACEs among people in treatment for SUD, it is crucial to continue evaluating the mediating mechanisms between specific types of ACEs and SUD diagnoses and the course of these patients in SUD treatment. Finally, there is a need for clinicians to consistently and routinely assess ACEs in the SUD treatment population with standardized criteria to implement tailored treatments.

These results emphasize the need for (a) developing research across different countries; (b) implementing adequate childhood maltreatment prevention policies to reduce its damaging consequences in adulthood; and (c) having specific training for professionals to detect the presence of ACEs and to provide SUD treatments containing an evaluation and a specific focus on these experiences and their consequences.

Contributors

Leire Leza, Sandra Siria, José J. López-Goñi, and Javier Fernández-Montalvo designed the protocol and wrote the article. Leire Leza conducted the literature search. Leire Leza and Sandra Siria carried out the study selection and data abstraction. José J. López-Goñi and Javier Fernández-Montalvo made the validation and supervision of the research. All authors contributed significantly to the research and have approved the final manuscript.

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Disclosures

Leire Leza, Sandra Siria, José J. López-Goñi, and Javier Fernández-Montalvo do not have any financial interests that may be interpreted as influencing the research.

Declaration of Competing Interest

The authors report no declarations of interest.

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