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MENTAL AND SOMATIC HEALTH OF CHILDREN AND ADOLESCENTS PLACED IN OUT-OF-HOME CARE: A SYSTEMATIC REVIEW OF COMPREHENSIVE HEALTH STUDIES

ABSTRACT

Purpose: *A comprehensive understanding of the health-related trajectories of children placed in out-of-home care (OHC) is beneficial in order to increase knowledge of the lifetime health status of these children. The aim of this systematic review was to summarize research evidence of studies investigating both psychiatric and somatic health of children and adolescents before, during or after OHC.* ***Methods:*** *This review followed the PRISMA guidelines. PubMed literature search was used to find studies on OHC from the perspective of healthcare. Eleven articles fulfilled the inclusion criteria.* ***Results:*** *Eight studies evaluated the mental and somatic health of participants during, three after and none before OHC. The findings show that during OHC both mental and somatic health conditions were more prevalent among OHC-placed children compared to their peers. The difference was most apparent in mental health outcomes. After OHC, the health status of children remained worse compared to non-OHC peers.* ***Conclusion:*** *Creating a more comprehensive picture of the health of the children in OHC is important. This enables the promotion of healthy mental and physical development among children in foster care services and to avoid long-term negative outcomes in their later health and coping in life. More research is warranted to simultaneously investigate mental and physical health of children who have experienced OHC placement. Lack of research especially occurs at the time before placement, thus research in future should focus particularly on this period. Unified systematic practices for assessing the comprehensive health status and ensuring required support of children in OHC is needed.*

KEYWORDS: MENTAL HEALTH, SOMATIC HEALTH, OUT-OF-HOME CARE, PSYCHIATRIC DISORDER, PHYSICAL ILLNESS, COMPREHENSIVE HEALTH STATUS

INTRODUCTION

Out-of-home care (OHC) is the most extreme form of social service measures. Common worldwide and concerns a remarkable part of the under-aged population in western societies [1]. Globally, approximately 3% of all children are placed in out-of-home care during their childhood [2]. Commonly these children and adolescents have had exposure to adverse childhood experiences (ACEs) [3] like maltreatment, poverty or parental drug and alcohol use [4]. ACEs are shown to associate, at population level, with many health-related conditions, like current depression, drug abuse and obesity [5].

Children and adolescents placed in out-of-home care have been reported to have poorer mental and physical health in comparison to population of the same age [6]. Overall, 30-80% of children who have entered foster care have shown to have at least one medical problem, and a third of these conditions are chronic by nature [7]. They are reported to be mental health, developmental, oral and psychosocial problems [7]. Of specified disorders and conditions, children in foster care have been shown to more likely have obesity, asthma, learning disabilities, developmental disorders of speech and developmental delays than children not placed in out-of-home care [6]. Further, these children are also more likely to be diagnosed with psychiatric disorders such as depression, ADHD, bipolar disorder and behavioural disorders compared to children never placed in out-of-home care [4,8]. It has been shown that, despite a multiplicity of mental health conditions, only half of the children placed in out-of-home care receiving psychiatric services were diagnosed before their first placement [8].

Out-of-home placement during childhood and adolescence has also been shown to be associated with far-reaching

unfavourable health and social outcomes, for example, increased risk of mental and physical health problems later in adulthood [9]. Further, the same study reported that out-of-home placement influences inability to work and the increased need of security disability insurance. A nationwide Finnish cohort study showed that children placed in OHC are more likely to meet criteria for multiple adverse health and social outcomes in adulthood compared to their siblings who had not been placed in OHC [10]. For example, it was shown that out-of-home placement is associated with increased risk for common psychiatric disorders, suicidality, injuries, premature mortality, experiencing violence, antisocial behaviours, violent crime arrests and poisoning injuries. Children in OHC have also been found to constitute a group of persons with a higher risk for later substance abuse, especially for smoking tobacco and marijuana [11]. Out-of-home care placement is also associated with a higher risk for later homelessness among young adults [12] and for subsequent mortality [13].

Several studies have been published on the health of children in out-of-home care and some reviews of the topic have been made as well. The reviews have concentrated mostly on studies examining mental or somatic health separately but not on studies addressing comprehensive health status, including both somatic and mental health. Further, the psychological needs and mental health of children in foster care have been studied more extensively than their physical health [14]. To the best of our knowledge, the studies reporting both mental and physical health findings of children and adolescents measured at different timepoints, i.e., before, during or after, in relation to timing of placement in out-of-home care, have not been summarized.

Acknowledging the current picture of research, and a comprehensive understanding of the health-related trajectories of children in out-of-home care, is needed to increase knowledge of the health status of these children. Evidence on this topic could be used for the development of services able to respond to these children, in a vulnerable position with health needs, at the earliest stage possible and for implications for further research. The purpose of this review is to summarize the evidence of studies that have investigated both the mental and somatic health of children and adolescents before, during or after placement in out-of-home care.

MATERIAL AND METHODS

We conducted a systematic review of relevant studies following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines [15].

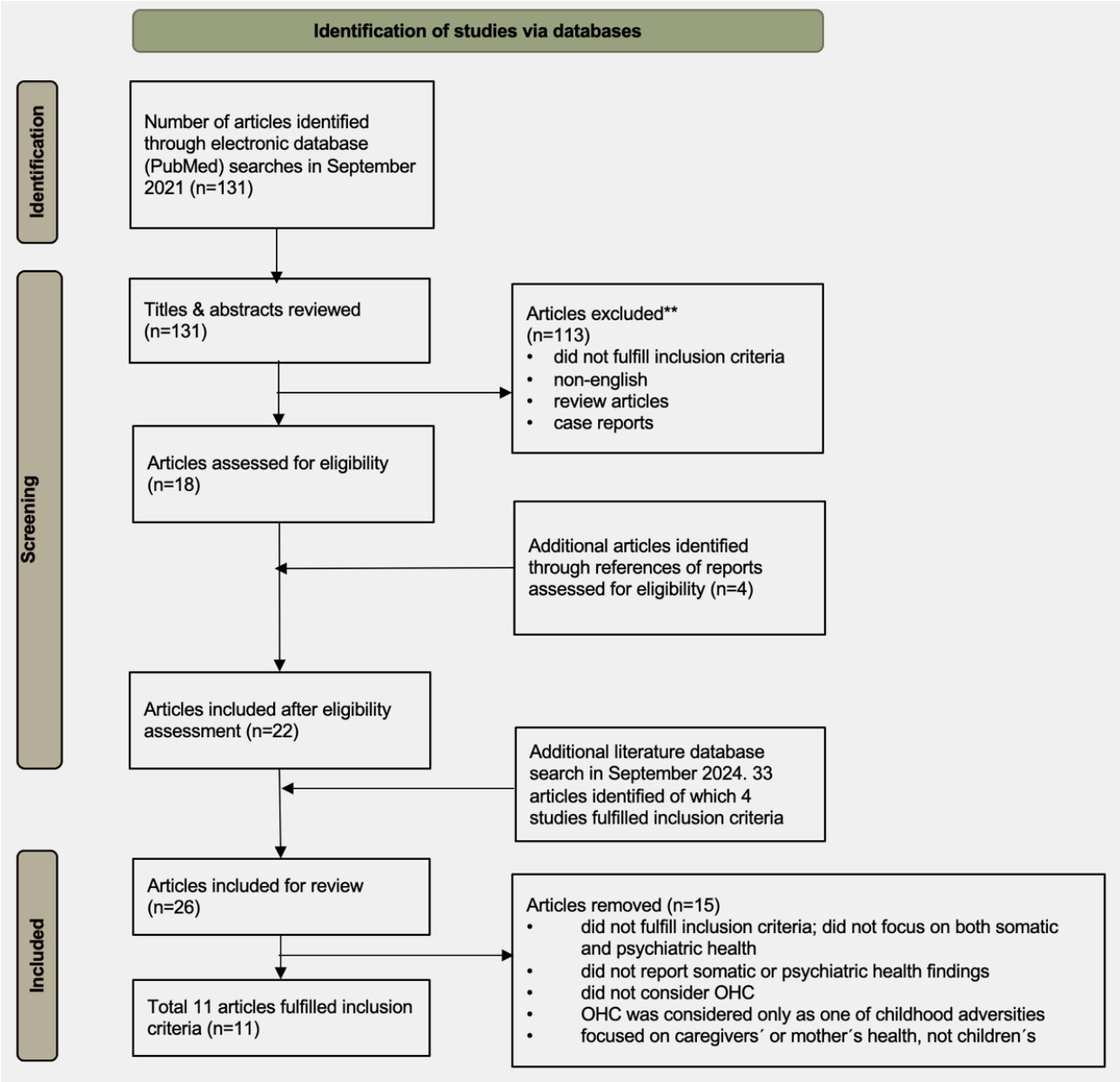
DATA SOURCES/SEARCH STRATEGY

We identified relevant studies by using a PubMed search to find studies concerning out-of-home care from the perspective of healthcare. We used a five-tiered search strategy to identify studies. A complete list of search terms used for each tier and information on how they were combined can be found in *Supplementary Table 1*. The search was conducted primarily in September 2021 and an additional literature search with same strategy was performed in September 2024. Electronic searches were supplemented with manual screening of reference lists of articles assessed for eligibility.

ARTICLE SELECTION PROCESS

The selection process of the articles followed the PRISMA guidelines [15], see *Figure 1*. Each record of the literature search was examined by scrutinizing the title and abstract. Two authors (SS and MN) reviewed the articles independently. In research group meetings the results were evaluated and disagreements resolved to reach a consensus decision. A total of 131 articles were identified as potential studies through the electronic database search in September 2021. By reviewing the titles and abstracts, 113 of the articles were excluded. 18 articles were assessed for eligibility and full papers were reviewed. Four additional articles were identified through examining reference lists of these articles. In an additional literature database search in September 2024 a total of 33 more articles were identified, of which 4 studies fulfilled inclusion criteria and were included in our evaluation of their eligibility for our review. A total of 15 of the 26 identified articles were excluded after careful reading of the full text versions. Eventually, 11 articles fulfilled the inclusion criteria and were included for final evaluation in our systematic review.

Figure 1. Selection of the articles.



INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria for articles were as follows: (1) Study design: cohort studies, follow-up studies or population-based studies, (2) Health of participants placed in out-of-home care: covering both mental and somatic health, (3) Time phase: before, during or after out-of-home care, (4) Date of publication: since 2010, (5) Language: English. Exclusion criteria were as follows: (1) Case reports, review articles and qualitative studies, (2) lack of out-of-home care, (3) no data of both mental and somatic health of participants. Mortality studies were excluded because they form their own entity.

DATA EXTRACTION

The following data were extracted (by MN, SS) from the included articles: name of the study and author(s), country of residence of participants, study design, recruitment and data source, study groups, reference sample, sample, age range of participants, time phase of evaluation of psychiatric and somatic health status in relation to out-of-home care, collection of psychiatric and somatic data (self-report or clinical assessment), the measure of psychiatric and somatic findings, objective of study, somatic and psychiatric findings, conclusion.

QUALITY ASSESSMENT

A modified STROBE (Strengthening the Reporting of Observational studies in Epidemiology) checklist [16] was adapted to assess the quality of each article for this systematic review (see *Supplementary Table 2*). For each article, two researchers (SS, MN) independently evaluated a checklist of 22 items for each article on three-point scale (0=not found/ not reported, 0.5=partly reported, 1=sufficiently reported). The sum score of an article could range between 0-22. Of eleven articles under review, a full agreement (i.e. both raters assigned the same score to an item) was reached for an average 64% (range 36%-100%) of all 22 checklist items. The majority of disagreements in item scores were related to whether to assign a score 0.5 or 1 (i.e. whether an item was partly or sufficiently reported in an article). Only in four articles was a total disagreement in an item score observed (i.e. one rater had given score zero and another rater either scored 0.5 or 1). The range of quality sum scores of the articles varied between raters (SS range 18-21, MN 12-20). In the final phase, all inconsistences in item scores were carefully checked by the raters and *Supplementary Table 3* reports the consensus value of these scores.

RESULTS

STUDY CHARACTERISTICS

The characteristics of the reviewed articles (n=11) are summarized in *Table 1*. Nine studies (81.1%) were from USA, the other two from Australia [17] and France [18]. The sample size of the reviewed studies varied from 74 [19] to 1 985 180 persons [20]. The analyses were generally stratified by gender (females 42% to 56%), except in one study with only males [19] and one article did not report gender distribution [17]. Study designs included longitudinal [17,19,21,22], cohort [6,20,23,24] and retrospective studies [18,24,25], and one register study [26]. The age range of study participants at baseline varied from 0 (foetus) [6,17,18,25] to 26 years [23]. Four articles included general and school-based or within-sample matched control groups [6,22,23,25].

STUDY METHODS

Table 2 shows the time phase of the evaluation of mental and somatic health status in relation to timing of placement in out-of-home care (OHC), as well as research instruments and methods applied in the studies. None of the articles identified for this review had evaluated the psychiatric and somatic health status of participants during the time period preceding placement in OHC. Eight of the studies had evaluated the health status of participants during [6,17,18,20,22,24,25,26] and three after OHC [19,21,23].

Data on mental health status was based on self-reports (interviews, questionnaires) in six of the articles [6,19,21,22,23,26], clinical assessment (ICD/DSM-criteria) in four articles [17,20,24,25] and both in one [18]. Regarding somatic health status, six studies were based on self-reports (interviews, questionnaires) [6,19,21,22,23,26], four on clinical assessment (diagnostic criteria, clinical examination) [17,20,24,25] and one having both [18].

Table 1. Characteristics of the articles included in the systematic review.

Study	Country and study design	Recruitment and data source	Participants			
			Study group(s)	Reference group(s)	Groups statistics (n, % of females)	Age range (years)
Ahrens et al. (2014) [23]	USA: national cohort study	data from two national cohorts; the Midwest Evaluation of the Adult functioning of Former Foster Youth (Midwest Study), the National Longitudinal Study of Adolescent Health (Add Health)	young adults formerly in foster care (FC group)	two general population groups age-matched with FC group; economically secure (ES group) and economically insecure (EI group)	FC group: n = 596, 56% females EI group: n = 456, 68% females ES group: n = 1461, 55% females	17 to 26 years, mean (SD) age: FC group: T1 = 17.8 (0.4), at T2 = 26.1 (0.3) ES group: at T1 = 19.8 (0.5), at T2 = 26.3 (0.4) EI group: at T1 = 19.9 (0.5), at T2 = 26.3 (0.4)
Jones (2014) [21]	USA: longitudinal study of residential facility cohort	data from interview and questionnaires; the Child Health Questionnaire, YASR, Ansel-Casey Life Skills Assessment - Short version	former foster youth	-	n = 129, 59.8% females	at least 17, (17-20 at first interview -> 19-22 at the last interview)
Kaferly et al. (2023) [25]	USA: retrospective registry study	Medicaid-enrolled children in Colorado, Medicaid eligibility codes to indicate foster and guardianship care, adoption from foster or guardianship care, and emancipation	foster care cohort of children ≤19 years with ≥1 month of Medicaid enrollment during the study period	age-matched peers	n = 1084026, 50.3% females	0 to 18 years
Kools et al. (2013) [22]	USA: longitudinal intervention study	Data from the Foster Youth Health Project (FYHP) to cluster adolescents into 13 health profiles Inclusion criteria: adolescents in foster care who were assigned to CASAs in three northern California counties	foster youth	school-based reference sample	foster youth: n = 136, 50.7% females school-based reference sample: n = 865	Foster care: range 11.2-18.9 years, mean (SD) age = 14.8 (1.9)
Kugler et al. (2012) [26]	USA: register study	Archival data of the residential facility between 1996 and 2011 Inclusion criteria: at least 8 years of age, had completed MASC, TSCC and CDI, primary caregivers had completed CBCL and an available file of background information regarding the child´s psychosocial history.	foster care children	-	n = 161, 44.7% females	range 8 to 17 years, mean (SD) age = 10.9 (2.2)
Lindley & Slayter (2018) [24]	USA: retrospective cohort analysis	Data from National Data Archive on Child Abuse and Neglect (NDACAN) Adoption and Foster Care Analysis and Reporting System (AFGARS) Inclusion criteria: children ≤ 18 years with residence in the USA. and death between 2005 and 2015.	foster care children	-	n = 3653, 42.1% females	under 18 years, mean (SD) age = 5.9 (6.6)

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Study	Country and study design	Recruitment and data source	Participants			
			Study group(s)	Reference group(s)	Groups statistics (n, % of females)	Age range (years)
Meinhofer et al. (2024) [20]	USA: population-based cohort study	Nationwide Medicaid claims data from 2014 to 2020 (Medicaid Analytical eXtract (MAX) and Transformed Medicaid Statistical Information System Analytic Files (TAF) Inclusion criteria: Medicaid-enrolled children with exposure to parental opioid use–related disorder (POUD) during ages 4 to 18 years	foster care children	-	n = 1 985 180 Medicaid-enrolled children, female = 49% females, person-years = 8 939 666	4 to 18 years
Neil et al. (2019) [17]	Australia: longitudinal population-based cohort study	Data from the Wave 2 linkage of the New South Wales Child Development Study (NSW-CDS). Data for analyses from the NSW Registry of Births, Deaths and Marriages, the NSW Ministry of Health´s Admitted Patient Data Collection and Perinatal Data Collection, and the NSW Family and Community Services´ Child Protection Case Management System - Key Information Directory System. Data of costs of hospitalization from National Hospital Cost Data Collection	Sub-groups: unknown to child protection services, known to child protection services and placed in out-of-home care	-	all children n = 79 285	range 0 to 13 years
Scott & McCoy (2018) [19]	USA: longitudinal study	an ongoing longitudinal study of older foster care youths in the care and custody of state authorities in a Midwestern state. Data comprised interviews, questionnaires and data on lifetime or past-year mental disorders	older foster care youths	-	n = 74, all males	range 18 to 19 years
Toussaint et al. (2023) [18]	France: retrospective study	data of all children entrusted to the care of the child protection and welfare service in Vendée	children placed to OHC	-	n = 623, female = 299 (48%), male = 324 (52%)	range 0 to 18 years
Turney & Wildeman (2016) [6]	USA: national survey	Data from the National Survey of Children´s Health (NSCH) 2011-2012, interviews of household adults (mostly parents) of focal children	foster care children	children not placed in foster care: subgroups for children adopted from foster care, children across specific family types, children in economically disadvantaged families	Non-institutionalized children n = 95 677, 48.8% females	range 0 to 17 years, mean age = 8.6

Note
Mental health measurements/classifications: YASR = Young Adult Self-Report (Jones, 2014), FYHP = Foster Youth Health Project (Kools, 2013), MASC = Multidimensional Anxiety Scale for Children (Kugler, 2012), TSCC = Trauma Symptom Checklist for Children (Kugler, 2012), CDI = Children's depression inventory (Kugler, 2012), CBCL = Child Behaviour Checklist (Kugler, 2012)
Somatic health measurements/classifications: FYHP = Foster Youth Health Project (Kools, 2013)
General abbreviations: FC = foster care (Ahrens, 2014), EI = economically insecure (Ahrens, 2014), ES = economically secure (Ahrens, 2014), CASA = Court Appointed Special Advocates (Kools, 2013), NDACAN = National Data Archive on Child Abuse and Neglect (Lindley, 2018), AFCARS = Adoption and Foster Care Analysis and Reporting System (Lindley, 2018), MAX = Medical Analytical eXtract (Meinhofer, 2024), TAF = Transformed Medicaid Statistical Information System Analytic Files (Meinhofer, 2024), NSW-CDS = New South Wales Child Development Study (Neil, 2019), NSW = New South Wales (Neil, 2019), NSCH = National Survey of Children´s Health (Turney, 2016)

Table 2. Data characteristics (time phase, method, measures) for somatic and psychiatric findings.

Study	Time phase of evaluation of psychiatric and somatic health status of children and youth in relation to timing of out-of-home care (OHC)	Somatic Health		Psychiatric Health	
		Evaluation method	Measures	Evaluation method	Measures
Kaferly et al. (2023) [25]	during OHC	clinical assessment	Pediatric Medical Complexity Algorithm, version 3.0 (PMCA) PMCA-derived chronic physical and chronic combined conditions, through all available fee-for-service and capitated behavioural health procedure and diagnostic code data	clinical assessment	ICD-10 (F00-F99)
Kools et al. (2013) [22]	during OHC	self-reports (children)	CHIP-AE (a composite measure of health status with six domains, an adolescent self-report instrument of subjective perceptions of the multidomain)	self-reports	CHIP-AE
Kugler et al. (2012) [26]	during OHC	self-reports (children, caregivers)	both caregivers and children answered certain questionnaires (CBCL)	self-reports (children, caregivers)	both caregivers and children answered certain questionnaires (CBCL, CDI, MASC, TSCC)
Lindley & Slayter (2018) [24]	during OHC	clinical assessment	The diagnosis of a chronic illness that required special medical care (e.g. cancer, HIV/AIDS, congenital anomalies)	clinical assessment	mental or behavioural health diagnosis (e.g. attention deficit and disruptive disorders, mood disorders, personality disorders) based on DSM
Meinhofer et al. (2024) [20]	during OHC	clinical assessment	ICD-10 and Current Dental Terminology codes	clinical assessment	ICD-10 (depression, anxiety, trauma and stress, ADHD, conduct disorder or impulse, suicidality or self-harm, autism or PDD, developmental delay)
Neil et al. (2019) [17]	during OHC	clinical assessment	ICD-10-AM, AR-DRG	clinical assessment	diagnoses recorded in ICD-10 Chapter V (F00-F99)
Toussaint et al. (2023) [18]	during OHC	both self-reports and clinical assessment	medical form, which comprised two sections: medical section completed by the doctor	both self-reports and clinical assessment	medical form completed by the doctor
Turney & Wildeman (2016) [6]	during OHC	self-reports from parents/ caregivers	interview (The outcome variables include 13 binary indicators of children's mental and physical health, all reported by the parent respondent. These also include 11 specific indicators of health conditions, measured affirmatively if the parent respondent reports the child has been diagnosed with the condition by a doctor or other healthcare provider and if the parent respondent reports the child has the condition at the time of the interview)	self-reports from parents/ caregivers	interview
Ahrens et al. (2014) [23]	after OHC	self-reports (youth)	interview (participants were asked for their general health, BMI and several chronic health conditions, also seizure disorder, asthma, dyslipidemia, hypertension and diabetes)	self-reports (children)	interview (including ADHD)

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Study	Time phase of evaluation of psychiatric and somatic health status of children and youth in relation to timing of out-of-home care (OHC)	Somatic Health		Psychiatric Health	
		Evaluation method	Measures	Evaluation method	Measures
Jones (2014) [21]	after OHC	self-reports (youth)	data from interview and questionnaires (CHQ)	self-reports (youth)	data from interview and questionnaires (YASR)
Scott & McCoy (2018) [19]	after OHC	self-reports (youth)	The Cardiovascular Arousal and Sleep Disturbances scale (CASD)	self reported (youth)	interview (the Diagnostic Interview Schedule, mental disorders based on DSM-IV)

Note
Mental health measurements/classifications: CHIP-AE = Child Health and Illness Profile-Adolescent Edition (Kools, 2013), CBCL = Child Behaviour Checklist (Kugler, 2012), CDI = Children's depression inventory (Kugler, 2012), MASC = Multidimensional Anxiety Scale for Children (Kugler, 2012), TSCC = Trauma Symptom Checklist for Children (Kugler, 2012), DSM = Diagnostic and Statistical Manual of Mental Disorders (Lindley, 2018), ICD = International Statistical Classification of Diseases and Related Health Problems (Meinhofer, 2024), ICD-10-AM = International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (Neil, 2019), AR-DRG = The Australian Refined Diagnosis Related Groups (neil, 2019), ADHD = Attention Deficit Hyperactivity Disorder (Ahrens, 2014), YASR = Young Adult Self-Report (Jones, 2014),
Somatic health measurements/classifications: PMCA = Pediatric Medical Complexity Algorithm (Kaferly, 2023), DSM = Diagnostic and Statistical Manual of Mental Disorders (Lindley, 2018), ICD = International Statistical Classification of Diseases and Related Health Problems (Meinhofer, 2024), ICD-10-AM = International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (Neil, 2019) , AR-DRG = The Australian Refined Diagnosis Related Groups (Neil, 2019), BMI = Body Mass Index (Ahrens, 2014), CHQ = Child Health Questionnaire (Jones, 2014), CASD = The Cardiovascular Arousal and Sleep Disturbances scale (Scott, 2018)

QUALITY OF STUDIES

Supplementary Table 2 shows the criteria for quality assessment of the articles according to the modified STROBE checklist, and *Supplementary Table 3* reports the quality scores of each article accepted for our systematic review. The quality sum scores of the articles in the review were consistently good, with the scores ranging from 20 to 22. This suggests that the articles exhibited good quality and consistency across the research topic under evaluation.

RESULTS

Findings of the reviewed studies are summarized in *Table 3*.

Mental Health During Out-Of-Home Care

Findings on mental health of children during OHC placement were reported in eight articles. Four articles reported findings about developmental health [6,17,18,24] and seven of mental/behavioural health problems [6,18,20,22,24,25,26]. Based on the self-reports and clinical assessments the children in OHC were reported to be at greater risk of having mental health problems compared to children not placed in OHC [6,20]. For example, in the clinical assessments, children in OHC exhibited higher rates of depression (10% vs 4%), anxiety (9% vs 5%), trauma and stress (35% vs 7%), conduct or impulse disorders (25% vs 12%), suicidality and self-harm (3% vs 1%), developmental delays (12% vs 7%) and substance use-related disorders (4% vs 1%) [20]. They were also more commonly diagnosed (36.5% vs. 12.1%) with behavioural health conditions [25]. In another study using clinical assessment, prior psychosocial stressors (removal from the home because of prior parental death, parental incarceration, parental inability to cope, parental abandonment, parental relinquishment or parental inability to provide adequate housing) among children in OHC were associated with increased likelihood for mental/behavioural health problems (aOR 1.53) [24]. In the other study based on clinical assessment, reasons behind hospitalizations among children with child protection services were predominantly sleep disorders and developmental disorders, including autism and oppositional defiant/conduct disorders [17].

According to the parent/caregiver self-reports, children in OHC were also more likely to have learning disabilities (14.7% vs 7.6%), developmental delays (7.3% vs 3.4%), speech problems (11.2% vs 4.7%), anxiety (14.2% vs 3.1%), behavioural problems (17.5% vs 2.9%) and depression (14.2% vs 2.0%) compared to children not in OHC [6]. For each diagnostic subgroup category for mental disorders (ICD-10: F-codes), the prevalence within the foster cohort exceeded those of peers, the most common categories being ADHD, anxiety, autistic and

major depressive disorders. Also, the psychiatric comorbidity rates were higher among the foster cohort compared to peers, the rate varying from 1.4% to 16% among foster cohort and from 0.2% to 5.2% among peers [25]. In another study using self-report questionnaires, somatic symptoms scores of children rated by their caregivers correlated positively with self-reported anxiety, depression, post-traumatic stress symptoms and dissociation among children in OHC. Children's age and time since removal from OHC, however, was shown to correlate. Children's age was negatively correlated with TSCC (Trauma Symptom Checklist for Children) anxiety (-0.18) and TSCC depression (-0.22). Time since removal was negatively correlated with TSCC subscales for anxiety (-0.21), depression (-0.21) and PTS (-0.16) [26].

Somatic Health During Out-Of-Home Care

Of eight studies reporting somatic health status of study participants during OHC, three of eight articles [17,22,25] reported the state of physical health at a general level. One study compared the population rate (per 10000 children) for hospitalization due to physical health conditions between three study groups of children (unknown to child protection services, known to child protection services, with at least one OHC placement before age 13 years). The rate was shown to decline by advancing age (by one-year age band) in the same pattern in each study group, except no change in rate was found in OHC group between ages 10 and 11 years. The population-based rates of physical hospitalizations were significantly higher for both children known to child protection services and in the OHC group compared with children unknown to child protection services (17). Further, based on clinical assessment, foster care children, compared to age-matched peers, were reported to have a higher rate of any physical health condition (1105.0 vs 685.1 per 100 000 person-months) [25]. One study utilizing children's self-reports [22] analysed health profiles of children in OHC in comparison to the school-based reference sample. The results showed that the OHC group, compared to reference sample, had relatively more "fair" (30.5% vs 29.6%), "poor" (17.6% vs 17.3%) and "worst" (13.0% vs 10.3%) health status and less "best" (38.9% vs 42.7%) health status.

Five [6,18,20,24,26] articles reported detailed findings of somatic health of children during OHC. Based on clinical assessment, prior maltreatment was shown to associate with increased sensory disability and motor disability, parental drug/alcohol use with decreased motor disability and psychosocial stressors with increased sensory disability and motor disability [24]. The study comparing fostered children to those without foster care involvement using clinical assessment, showed that fostered children exhibited higher rates of physical health conditions such as hearing problems (2% vs 1%), vision problems (3% vs 2%), middle-ear infection (13% vs 11%), respiratory infection (36% vs 35%), dental problems (7% vs 5%), dermatological problems (15% vs 13%), injuries (20% vs 18%) and complex chronic conditions (6% vs 5%) [20]. Furthermore, one study reported that 41% of the children in OHC had a medical history, 8% were in long-term care for illness, as well as 19% having regular medical treatment, of which 18% was asthma medication or antihistamines [18]. Children who had experienced sexual abuse as a psychological stressor had self-reported significantly more somatic symptoms (SS) than those without exposure to sexual abuse [26]. In the same study, females had higher prevalence of being dizzy and sick to stomach compared to males. Further, according to primary caregiver ratings, dizziness, nausea, stomach aches and vomiting were more common in females, while males had more restlessness [26]. Another study using self-reports found that children in OHC had activity limitations more commonly and they were more likely to have asthma than children not placed in OHC [6].

Mental Health After Out-Of-Home Car

Three [19,21,23] of eleven articles under review reported mental health findings in children discharged from OHC. All the findings were based on youths' self-reports. As for mental illnesses diagnosed after OHC, youths from OHC were reported more likely to have been diagnosed with ADHD compared to youths without OHC [23]. Further, physical abuse was shown to have a positive correlation with physical neglect (0.29), emotional abuse (0.71) and hiding feelings (0.31) [19]. One study documented that alcohol use, drug use and substance use varied but in total increased during follow-up period of three years after OHC [21].

Somatic Health After Out-Of-Home Care

In all three articles reporting health after OHC, physical health findings of the study subjects were based on youths' self-reported data. Two articles focused on experiences of general health status [21,23]. One study followed the health status of former foster youths three years after discharge from OHC and showed that the best health status was found at the nearest time point after discharge [21]. Further, children with a history of OHC were documented to have a higher likelihood of reporting poor or fair general health (OR 2.30) compared to children who had lived in an economically secure family environment and without history of OHC placement [23]. In their study, the youths with a history of OHC were more likely

to have cardiovascular risk factors than their peers. Negative correlation was found between seeking social support after OHC and somatic symptoms (-0.24), and meeting diagnostic criteria for conduct disorder was related to increased somatic symptoms [19].

Table 3. Main findings, conclusions, clinical recommendations and research implications of the reviewed studies.

Study	Objective of the study	Findings, somatic health	Findings, psychiatric health	Conclusion
During out-of-home care (OHC)				
Kaferly et al. (2023) [25]	To determine the prevalence and rates of physical, behavioural and chronic health conditions among Medicaid-enrolled children by foster care eligibility codes	Foster care children vs. peers: • Any physical health condition, rate per 100000 PMs (person months): 1105.0 PMs vs. 685.1 PMs • Chronic health conditions with behavioural health condition (55.2% vs. 38.6%) For both study groups the most common body-system conditions were respiratory/ pulmonary, neurologic and any progressive	Foster care children vs. peers: • Diagnosed behavioural health condition (36.5% vs. 12.1%,), rates increased with age and were higher in men • For each F-code category, prevalence within the foster cohort exceeded those of peers. Four most common were anxiety disorder, F41.9 (32.4% vs. 7.9%), ADHD, F90 (18.2% vs. 3.8%), autistic disorder, F84.0 (15.8% vs. 5.6%), major depressive disorder, F32.0 (13.9% vs. 4.6%) • Comorbidity rates among four main F-code categories were higher among foster cohort compared to peers (2 categories: 16.0% vs. 4.1%, 3 categories: 5.2% vs. 0.7%, all 4 categories: 1.4% vs. 0.2%)	Psychosocial stressors like maltreatment predicted poor physical, mental and developmental health
Kools et al. (2013) [22]	To define health profiles of adolescents during OHC	OHC children vs. school-based sample: • Excellent health (21.4% vs. 14.3%), high discomfort (6.9% vs. 5.2%), high risks (12.2% vs. 9.0%), dissatisfied/high risks (2.3% vs. 1.9%), high discomfort/ high risks (4.6% vs. 1.7%), worst health (13.0% vs, 10.3%) • Combined health categories: Fair (30.5% vs. 29.6%), poor (17.6% vs. 17.3%), worst (13.0% vs. 10.3%) and best health status (38.9% vs. 4.2.7%)	Foster care group: • 35.3% of those with worst health status and 7.8% of those with best health status had history of sexual abuse • 29.4% of adolescents with worst health status had aggression, substance abuse and suicidality, of those with best health status, 17.6% had aggression, 5.9% substance abuse and 2.0% suicidality • 17.4% with poor health and 2.0% with best health had experienced a death or a suicide of parent	Children experiencing parental opioid use disorder were involved with the foster care system at faster rates than children in the general population. Foster care involvement was associated with worse mental health, developmental, and substance use–related outcomes and with higher healthcare utilization. Children are more likely to receive healthcare services while in foster care but cease to receive these services after exiting care and are less likely to receive them prior to entering care

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Study	Objective of the study	Findings, somatic health	Findings, psychiatric health	Conclusion
Kugler et al. (2012) [26]	To determine the extent of association between somatic symptoms (SS) and clinical variables (i.e. type of abuse, anxiety, post-traumatic stress symptoms, anger, dissociation and depression)	Foster care children: • Children who had experienced sexual abuse reported to have significantly more SS than those without experience of sexual abuse (t(159)=2.69)) • On the child-rated measure of SS, gender difference (females vs. males) was found in dizzy (1.26 vs. 0.79) and sick to stomach (1.25 vs. 0.85) and sum of SS (13.28 vs. 10.65). • On the primary caregiver-rated SS, gender difference (females vs. males) was found in restless (0.76 vs. 1.07), dizzy (0.10 vs. 0.02), nausea (0.15 vs. 0.06), stomach aches (0.22 vs. 0.08) and vomiting (0.11 vs. 0.01) • Child-rated SS correlated positively with age (r=0.17) • Caregiver-rated SS correlated negatively with age (r=-0.21)	Foster care children: • Children who had experienced sexual abuse reported to have significantly more SS than those without experience of sexual abuse (t(159)=2.69)) • On the child-rated measure of SS, gender difference (females vs. males) was found in dizzy (1.26 vs. 0.79) and sick to stomach (1.25 vs. 0.85) and sum of SS (13.28 vs. 10.65). • On the primary caregiver-rated SS, gender difference (females vs. males) was found in restless (0.76 vs. 1.07), dizzy (0.10 vs. 0.02), nausea (0.15 vs. 0.06), stomach aches (0.22 vs. 0.08) and vomiting (0.11 vs. 0.01) • Child-rated SS correlated positively with age (r=0.17) • Caregiver-rated SS correlated negatively with age (r=-0.21)	Mental health hospitalizations for OHC children, 2.5 % of the cohort, were 5-fold greater than expected
Lindley & Slayter (2018) [24]	To study association between prior trauma exposure (maltreatment, parental drug/ alcohol use, psychosocial stressors) and serious illness among foster children at end of their life	34.1% of foster children had physical health problems, 10% sensory disabilities and 15% motor disabilities 68% had experienced maltreatment, 28% exposure to parental drug/alcohol misuse, and 39% psychosocial stressors Prior maltreatment associated (aOR, 95%CI) to • Physical health problems (aOR 1.78, 1.50-2.12) • Sensory disability (aOR 1.68, 1.27-2.22) • Motor disability (aOR 1.44, 1.15-1.80) Psychosocial stressors to • Physical health problems (aOR 1.48, 1.27-1.73) • Sensory disability (aOR 1.52, 1.20-1.93) • Motor disability (aOR 1.49, 1.22-1.82) Parental drug/alcohol use to * Motor disability (aOR 0.79, 0.62-0.99)	10% of foster children had mental/ behavioural health problems and 10% intellectual disabilities 68% had experienced maltreatment, 28% exposure to parental drug/alcohol misuse and 39% psychosocial stressors Prior maltreatment associated (aOR, 95%CI) to • intellectual disability (aOR 1.61, 1.23-2.10) Prior psychosocial stressors associated to • mental/behavioural health problems (aOR 1.53, 1.20-1.96) • Intellectual disability (aOR 1.40, 1.11-1.77) i Parental drug/alcohol use to • Intellectual disability (aOR 0.72, 1.11-1.77)	Children and adolescents in OHC have significantly higher healthcare needs compared to their peers
Meinhofer et al. (2024) [20]	To examine the health and healthcare outcomes of children experiencing parental opioid use disorder (POUD) with and without foster care involvement	Foster children vs. children without foster care involvement (rate difference, 95%CI): • Asthma (8% vs. 8%, diff 0.39, 0.25-0.52) • Hearing problem (2% vs. 1%, diff 0.92, 0.86-0.99) • Vision problem (3% vs. 2%, diff 1.35, 1.27-1.43) • Middle-ear infection (13% vs. 11%, diff 1.19, 1.05-1.33) • Respiratory infection (36% vs. 35%, diff 0.72, 0.51-0.93) • Dental problem (7% vs. 5%, 1.19, diff 2.06-2.27) • Dermatological problem (15% vs. 13%, diff 2.19, 2.04-2.34) • Injuries (20% vs. 18%, diff 3.45, 3.29-3.62) • Complex chronic condition (6% vs. 5%, diff 1.67, 1.56-1.79)	Foster children vs. children without foster care involvement (rate difference, 95%CI): • Depression (10% vs. 4%, diff 6.05, 5.91-6.19) • Anxiety (9% vs. 5%, diff 4.84, 4.71-4.98) • Trauma and stress (35% vs. 7%, diff 27.4, 27.2-27.6) • ADHD/conduct or impulse disorder (25% vs. 12%, diff 14.0, 13.7-14.2) • Suicidality and self-harm (3% vs. 1%, diff 2.05, 1.98-2.13) • Developmental delays (12% vs. 7%, diff 4.91, 4.74-5.07) • Substance use–related disorders (4% vs. 1%, diff 2.96, 2.88-3.05)	Children placed in out-of-home care have poorer mental and physical health compared to children not placed in out-of-home care

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Study	Objective of the study	Findings, somatic health	Findings, psychiatric health	Conclusion
Neil et al. (2019) [17]	To estimate the costs of hospitalization by child protection status, including out-of-home care (OHC) placement, and to assess the excess costs associated with child protection contact	Study addressed general physical health-related reasons for hospitalizations, no accurate diagnoses-based information The rate of hospitalization for physical health condition reduced with age for all subgroups except for the OHC subgroup at 10 ≤11 years	The study addressed all psychiatric diagnoses (ICD-10 Chapter V (F00-F99)). At 0 ≤ 1 year hospitalizations were predominantly for sleep disorder and at 1 ≤ 5 years sleep disorders, developmental disorders including autism and oppositional defiant/conduct disorders were the most prominent diagnoses According to child protection status, there was no consistent trend in the population rate for children hospitalized for mental health reasons In the first year of life the rate of hospitalization for mental health reasons were significantly lower for the children ever placed in OHC (9151.8 children/ 10000 population) compared to children unknown (9480.3/10000) and known (9456.1/10000) to child protection services	Mental health hospitalizations for OHC children, 2.5 % of the cohort, were 5-fold greater than expected
Toussaint et al. (2023) [18]	To explore overall health status of children entrusted to care of the child protection and welfare service	Of all children placed to OHC (foster care, residential care) • 41% had a medical history (for example, atopic condition, allergy, surgical history) • 8% were under long-term care for illnesses such as diabetes, epilepsy, genetic disease or rarer chronic diseases • 19% were under regular medical treatment, of which 18% were long-term treatment for asthma or an antihistamine • 68% of children had a normal BMI, 16% were below <-2SD, 13% were overweight and 3% were obese • 30% had orthodontic problems and 12% had caries	Of all children placed to OHC • 51% manifested their psychological suffering • 8% were under long-term care for illnesses such as autism, ADHD • 29% written or oral language disorder and 5% were diagnosed with "dys-" problems • 29% had sleep disorders • 19% were under regular medical treatment, 43% of these were psychiatric treatments • 16% of children over the age of 6 years already ran away or put themselves in danger (unprotected sex, sexual photos posted on social networks, criminal acts, multiple addictions with loss of self-control, dangerous acts in a car, etc.) • 44% of 501 of the study children had visual problems • 54% benefited from follow-up care, including psychomotor (15%), psychological (45%), or child psychiatric (21%) therapist • In over 12-year participants, 17% has admitted to regular tobacco use, 12% to regular alcohol use and 6% to regular cannabis use	Children and adolescents in OHC have significantly higher healthcare needs compared to their peers

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Study	Objective of the study	Findings, somatic health	Findings, psychiatric health	Conclusion
Turney & Wildeman (2016) [6]	To compare somatic and psychiatric health between children with and without history of placement in out-of-home care.	Children with OHC vs. no OHC placement (prevalence, OR, 95%CI): • Activity limitations (9.8% vs. 4.8%, OR 2.15, 1.34-3.44) • Asthma (18% vs. 8.7%, OR 2.32, 1.39-3.87) When adjusted for child´s characteristics likelihood for asthma (OR 2.10, 1.19-3.70) and activity limitations (1.85, 1.12-3.06) remained significant	Children with OHC vs. no OHC placement (prevalence, OR, 95%CI): • learning disabilities (14.7% vs. 7.6%, 2.09, 1.29-3.38), developmental delays (7.3% vs. 3.4%, 2.25, 1.36-3.72), speech problems (11.2% vs. 4.7%, 2.56, 1.40-4.68) • ADD/ADHD (21.8% vs. 7.4%, 3.51, 2.22-5.56), anxiety (14.2% vs. 3.1%, 5.10, 3.16-8.25), behavioural problems (17.5% vs. 2.9%, 7.17, 4.37-11.77) and depression (14.2% vs. 2.0%, 8.15, 4.89-13.60) When adjusted for child characteristics, a greater likelihood for ADHD/ADD (OR 4.29, 2.68-6.88), learning disability (1.90, 1.13-3.21), depression (8.88, 4.84-16.27), anxiety (6.20, 3.73-10.30), behavioural problems (7.53, 4.45-12.74), developmental delay (2.03, 1.21-3.41) and speech problems (2.68, 1.41-5.08) remained significant When adjusted for household characteristics, a greater likelihood for ADD/ADHD (3.00, 1.91-4.71), depression (4.92, 2.63-9.18), anxiety (3.94, 2.36-6.60), behavioural problems (4.22, 2.59-6.88) and speech problems (1.91, 1.01-3.61) among children in OHC remained significant	Children placed in out-of-home care have poorer mental and physical health compared to children not placed in out-of-home care
After out-of-home care				
Ahrens et al. (2014) [23]	To evaluate the risk of cardiovascular risk factors and other chronic conditions among young adults	Former foster care (FC) group vs. economical secure general population (ES) group: • poor or fair general health (FC vs. ES) (OR 2.30; 95% CI, 1.84 to 2.89) • females: high BMI (B = 1.73 CI 0.86-2.61) • males: low BMI (B = -0.26 CI -1.07-0.55) • At least one cardiovascular risk factor (FC vs. ES B = 2.20 Cl 1.76-2.76), EI vs. ES B = 1.65, Cl 1.32-2.06) These gaps were wider for females than males	FC group was the most likely to report ADHD. EI group was less likely to report ADHD than the ES group	Former foster youth have a higher risk of multiple chronic health conditions, beyond that which is associated with economic insecurity

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Study	Objective of the study	Findings, somatic health	Findings, psychiatric health	Conclusion
Jones (2014) [21]	To present health problems and access to care among former foster youth	Former foster youth (n=129): At 6 months after discharge from OHC (n=92): • 22.8% excellent health, 27.2% very good health, 30.4% good health, 18.5% fair and 0% poor health At 1 year after discharge (n=66) • 16.7% excellent health, 15.2% very good, 45.5% good health, 13.9% fair and 9.9% poor health At 2 years after discharge (n=43): • 14.0% reported excellent health, 34.9% very good, 27.9% good, 14.0% fair and 9.3% poor health At the interview 3 years after discharge (n=16): • 25.0% reported excellent health, 12.5% very good, 37.5% good, 25.0% fair and 0% poor health	Former foster youth: • Clinical or borderline alcohol use: 6 months 17.8%, 1 year 18.2%, 2 yrs 19.0%, 3 yrs 37.5% • Drug use: 6 months 27.5%, 1 year 28.8%, 2 yrs 25.6% 3 yrs 31.3% • Substance use: 6 months 23.9%, 1 year 27.6%, 2 years 26.8%, 3 years 31.3% • Total problems: 6 months 18.5%, 1 year 14.3%, 2 yrs 7.0%, 3 yrs 12.5% • External problems: 6 months 23.9%, 1 year 15.2%, 2 yrs 16.7%, 3 yrs 18.8% • Internal problems: 6 months 10.9%, 1 year 7.6%, 2 yrs 14.0%, 3 yrs 18.8% • Any clinical or borderline diagnosis: 6 months 30.5%, 1 year 25.8%, 2 yrs 20.9%, 3 yrs 26.7% • Any clinical or borderline mental health and substance use diagnosis: 6 months 50.5%, 1 year 52.4%, 2 yrs 38.1%, 3 yrs 46.7%	During three years after discharge from foster care the mental health problems and substance abuse remained high among former foster youth
Scott & McCoy (2018) [19]	To study the association between somatic symptoms and psychological factors among males transitioning from foster care	Negative correlation was found between seeking social support and somatic symptoms (correlation -0.24, p<0.5). Symptoms of conduct disorder increased somatic symptoms	Physical abuse had positive correlation with physical neglect, emotional abuse and hide feelings.	Conduct disorder and seeking social support coping strategies had a significant effect to somatic symptoms

Note
Mental health measurements/classifications: ADHD = Attention Deficit Hyperactivity Disorder (Kaferly, 2023, Meinhofer, 2024, Toussaint 2023, Turney, 2016 Ahrens, 2014), CDI = Children's Depression Inventory (Kugler, 2012), TSCC = Trauma Symptom Checklist for Children (Kugler, 2012), PTS = Post-traumatic stress subscale (Kugler, 2012), ICD-10 = International Statistical Classification of Diseases and Related Health Problems, 10th Revision (Neil, 2019) ADD = Attention Deficit Disorder (Turney, 2016)
Somatic health measurements/classifications: SS = somatic symptom (Kugler, 2012), ICD = International Statistical Classification of Diseases and Related Health Problems (Neil, 2019), BMI = Body Mass Index (Toussaint, 2023, Ahrens, 2014)
General abbreviations: FC = foster care (Ahrens, 2014), ES = economically secure (Ahrens, 2014)

DISCUSSION

This systematic review aimed to clarify the understanding of health-related trajectories of children placed in out-of-home care. The aim was to elucidate studies concerning both the somatic and mental health of children in OHC in relation to the timing of placement in OHC.

An important finding of this review was that the number of articles that comprehensively reported both somatic and mental health of children placed in OHC was small, and there were no studies addressing the issue of before the placement. The small number of studies addressing comprehensive health, and their absence before OHC, was surprising, because there is a plethora of studies focusing and reporting either on only mental or physical health of children involved in OHC. It was also noteworthy that despite the inclusion criteria of the review, including articles reporting findings on both somatic and psychiatric health, the studies did not report the integrated findings of somatic and psychiatric health, and thus a comprehensive picture of health was not formed. However, since the mental and somatic health of persons are strongly linked and have a bidirectional impact on one another, research-based information including both aspects are needed and particularly in vulnerable populations like children placed in out-of-home care.

According to this review, the vast majority (73%) of the studies focused on examining the health of children during

their OHC placement. A plausible explanation for this is that during OHC, children are easily reachable for research purposes and these children are under continuous observation. Further, accessibility to research at this time point may be better, because personnel of OHC or foster parents have a duty to take care of the health of these children. It is notable that we did not find any study addressing the time before the placement in OHC, and only three reviewed articles analysed the health of children after discharge from OHC. The lack of published studies of the health status of children before their OHC placement is concerning and indicates a notable research gap of knowledge of the comprehensive health status of children in OHC. A firm and research-based understanding of the health of children before their placement is needed to find targets for early prevention of health-related adversities. Early intervention in health problems would be important because these problems are known to have a significant impact on success at school and also on later professional career [27].

In the reviewed studies, the follow-up of children with a history of OHC ended at the latest during young adulthood at the age of 26. Thus, there are no studies reporting findings of their comprehensive health in later adulthood. This finding, together with the absence of studies from the period before OHC, indicates that there is a research gap in studies that examine the lifetime trajectory of the comprehensive health of children in OHC. Much longer follow-up studies of OHC-placed persons, for example, by utilizing long-term national cohorts, would be important because there are earlier studies which indicate that OHC is associated with far-reaching unfavourable health and social outcomes, including increased risk of mental and physical health problems and inability to work [9].

The findings of our systematic review show that there are many differences between the mental and somatic health of children placed in OHC when compared to those without a history of OHC. For example, it was shown that of physical health conditions, chronic illnesses are more prevalent among foster care children compared to their peers [25]. However, it is notable that differences between the health of these two groups are most apparent in mental health outcomes [6]. An important finding concerning excess of somatic symptoms that was based on self-reports of children who had experienced sexual abuse who had significantly more somatic symptoms than those without this experience [26].

In our review only two studies were identified that examined direct differences between boys and girls [25,26], although nine studies reported the number of different genders in study samples. In the study of Kafferly et al. 2023, self-reported information on the health of children during OHC reported that girls had more dizziness, stomach aches, nausea and vomiting, compared to boys. Of mental symptoms, males had more restlessness compared to females. In the future it would be important to study more comprehensively the differences in health between boys and girls in OHC to be able to develop and direct more specific support for these children.

An important finding in this review about the methodologies of the evaluated studies was that in six of the eleven studies the findings were based on self-reports through interviews or questionnaires [6,19,21,22,23,26], and in only five articles were the findings based on clinical assessment and diagnosed disorders according to ICD- or DSM-based criteria [17,18,20,24,25]. However, despite the differences in research methods used, the results were consistent. It is also notable that the findings in all three studies that focused on health after OHC were based only on self-reports [19,21,23]. A relatively small number of studies based on objective assessment had an impact on the reliability of the results concerning health status. Therefore, it is justified to conclude that more studies with accurate diagnostic methods are needed to form a more specific picture of health of children and youth in OHC.

STRENGTHS AND LIMITATIONS

The main strength in this review was the systematic information retrieval which followed the PRISMA guidelines [15]. The quality assessment of the reviewed studies was performed by using a modified STROBE checklist [16] by whole study group.

This review has some limitations as well. First, the articles were searched by using the medical literature search interface of PubMed, and as a result it is possible that some articles may have been missed, because other databases, like Google Scholar, Scopus or Web of Science, were not utilized. However, we believe that we have found all relevant medical studies around this topic, because in this review we focused on health conditions which are most commonly reported in medical journals and we utilized the most common and comprehensive medical database [29]. One weakness in terms of generalizability of the results was that our review included only one article from Europe and the others were from USA and Australia. These countries, however, represented well the Western world.

CLINICAL RECOMMENDATIONS

The clinical health status and treatment needs of children placed in out-of-home care need be comprehensively evaluated,

covering all time phases in relation to OHC, i.e. before, during and after placement in out-of-home care. The evaluation of health status during OHC placement is of great importance, to provide and ensure timely support and treatment, especially for mental disorders and also for physical health conditions. Our findings revealing the small number of comprehensive health-related studies and the clear research gap in studies before placement indicate that health assessments are not fulfilled appropriately, although they are based on legislation. On a practical level, unified and systematic models [30] to assess the comprehensive health of the children in OHC are urgently needed to ensure health-related services [31] for these children. At the transition phase from out-of-home care to independent life, the possible need for treatment and the arrangement of treatment should be considered, as the state of health of these people is known to be weaker in the long term.

CONCLUSION

This review clearly demonstrated a paucity of research comprehensively analysing both the mental and physical health status of children needing placement in out-of-home care. The majority of the studies under review examined the health of children during OHC, but none had focused on the time frame before entering OHC. Creating a more thorough picture of the health of these children is important in order to be able to promote their healthy mental and physical development and avoid long-term negative outcomes in their later health and coping in life. In Finland, this issue is currently particularly important due to the recent and ongoing reform of social and wellbeing services, which has transferred responsibility for children's social and healthcare to wellbeing services counties.

Supplementary Material

Supplementary data are available at Psychiatria Fennica online.
Table 1.
Table 2.
Table 3.

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