What do we know about child abuse and neglect patterns of co-occurrence? A

systematic review of profiling studies and recommendations for future research

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Abstract

Latent class (LCA) and latent profile (LPA) analysis represent methodological approaches to identify subgroups of maltreated individuals. Although research examining child abuse and neglect (CAN) profiles is still rare, the application of person-centered techniques to clarify CAN types co-occurrence has substantially increased in recent years. Therefore, the aim of the present study was to provide a summary and critical evaluation of the findings of LCA/LPA child maltreatment research to: (*a*) systemize the current understanding of patterns of maltreatment across populations and (*b*) elucidate interactive effects of CAN types on psychosocial functioning. A search in PsychInfo, Eric, PubMed, Scopus, and Science Direct, and Google Scholar was performed. Sixteen studies examining the co-occurrence between child physical abuse, emotional abuse, sexual abuse, neglect, and/or exposure to domestic violence were identified. A critical review of the studies revealed inconsistent findings as to the number of CAN classes, but most research uncovered a poly-victimized and a low abuse group. Further, multiple victimization was associated with most adverse internalizing and externalizing outcomes, especially when sexual abuse was present. Exposure to physical and emotional abuse was frequently reported to lead to behavioural problems. Based on the present study results, we provide a set of recommendations for surpassing the current methodological and conceptual limitations in future research.

Keywords: Child abuse and neglect (CAN); Profiling research; Latent class analysis; Latent profile analysis; Systematic review

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Prevalence of child abuse and neglect (CAN)

Child maltreatment is a global problem associated with a variety of adverse

consequences (Shaw & De Jong, 2012; World Health Organization [WHO], 2016). Whilst

approximately 1% of children in the population have maltreatment substantiated every year,

survey studies demonstrate a much higher proportion of children with a history of

maltreatment than officially reported by child protection services (CPS) (Gilbert *et al.*, 2009;

Jütte *et al.*, 2015). According to a recent meta-analysis of the global prevalence of child

maltreatment, 7.6% of boys and 18% girls experience sexual abuse, 22.6% of children

experience physical abuse, 35.3% experience emotional abuse, and 18% of children are

neglected (Stoltenborgh, Bakermans-Kranenburg, Alink, & van IJzendoorn, 2015). The

results of such international syntheses, however, should be interpreted with caution due to the

lack of global consensus as to what constitutes CAN and differing data collection

methodologies applied across studies (Rumble, Ramly, Nuryana, & Dunne, 2017). Although

rates of maltreatment appear to be higher among females than males (Al-Fayez, Ohaeri, &

Gado, 2012; WHO, 2016), male victims are less likely to disclose abuse – and sexual abuse

in particular – which may be due to the social stigma and perceived loss of masculinity

associated with being victimized and subsequent disclosure (Finkelhor & Browne, 1985;

Johnson *et al.*, 2006). Further, the prevalence of CAN appears increased among some

disadvantaged populations. For example, research indicates that in excess of 60% of prisoners

experienced childhood victimization (Williams, Papadopoulou, & Booth, 2012).

Consequences of CAN and current research limitations

CAN has been implicated in the development of serious socio-emotional problems, including depression, posttraumatic stress disorder (PTSD), anxiety, aggression, self-harming behavior, suicide, educational underachievement, risky sexual behavior, and serious offending including homicide (Boduszek, Hyland, & Bourke, 2012; Dhingra, Boduszek, & Sharratt, 2015; Jones, Trudinger, & Crawford, 2004; Kendall-Tackett, Williams, & Finkelhor, 1993; Lundberg-Love, Marmion, Ford, Geffner, & Peacock, 1992; Mills, Kisely, Alati, Strathearn, & Najman, 2016; Vachon, Krueger, Rogosch, & Cicchetti, 2015). Research also reports that youngsters who have experienced abuse are less ambitious, have fewer friends, and lower self-esteem than their non-abused counterparts (Al-Fayez *et al.*, 2012; Oates, Forrest, & Peacock, 1985; Tong, Oates, & McDowell, 1987).

Studies into psychosocial effects of CAN are crucial for developing appropriate intervention and prevention strategies. However, to date, such investigations have mainly utilized traditional variable-centered statistical approaches, which focus on associations between study variables and do not control for the co-occurrence between various types of CAN (Green *et al.*, 2010; Scott, Varghese, & McGarth, 2010). Recent empirical evidence suggests that different forms of maltreatment are likely to overlap and interact and that those specific combinations, rather than subtypes of abuse alone, may be uniquely related to particular psychosocial consequences (Green *et al.*, 2010; Hamby & Grych, 2013; Wolfe & McGee, 1994). CAN profiles and associated criteria can be elucidated using person-oriented techniques (De Fruyt & De Clercq, 2014).

Person-centered analyses in developmental psychology research

Recent years have witnessed an increased interest in and use of person-centered statistical techniques, such as latent class (LCA) and latent profile (LPA) analysis, in the field of developmental psychology (Laudy *et al.*, 2007). These procedures have the power to

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identify typologies of people by examining the ways in which numerous traits are configured within individuals. Therefore, as opposed to variable-centered procedures, person-centered approaches do not assume independence among indicators (De Fruyt & De Clercq, 2014; Shevlin & Elklit, 2008). Prior LCA/LPA studies have identified patterns of co-occurrences for delinquent behaviors among adolescents (D'Unger, Land, & McCall, 2002; Odgers *et al*., 2007), comorbidity patterns for disruptive behavior disorders (de Nijs, van Lier, & Verhulst, 2007), and adolescents' loneliness profiles (Shevlin, Murphy, & Murphy, 2014). Although sparsely, LCA and LPA have also been employed in child maltreatment research, producing valuable information about maltreatment intensity and the heterogeneity in endorsement patterns among different samples (Roesch, Villodas, & Villodas, 2010).

LCA and LPA: What are they?

LCA and LPA are statistical methods employed to ascertain the number of homogeneous latent groups from categorical (in case of LCA) or continuous (LPA) multivariate data (Gibson, 1959; Hagenaars & McCutcheon, 2002; Lanza, Flaherty, & Collins, 2003; Lazarfeld & Henry, 1968; McCutcheon, 1987). Both LCA and LPA assume that associations among a set of observed variables can be explained by a finite number of mutually exclusive classes. The techniques allow for data exploration without the necessity to formulate any *a priori* assumptions with regard to the number of latent classes present and hence are well suited for research in fields which have not been studied extensively and where theories do not exist (Jansen & van der Maas, 1997; Thomas & Hettmansperger, 2001), thus supporting scientific progress.

In LCA/LPA environment, the optimal number of classes (class enumeration) is determined following multiple model assessments. There is no consensus as to a single statistical index that identifies the best-fitting model in a population (Nylund, Asparouhov, & Muthén, 2007). Thus, models with a successive number of classes are specified through an

iterative process. Extraction of latent classes terminates when there is little empirical or substantive support for the inclusion of a further class. Model fit is evaluated based on goodness of fit statistical and parsimony considerations. Statistical indices reported in LCA/LPA research include: Akaike Information Criterion (AIC; Akaike, 1974), Bayesian Information criterion (BIC; Schwarz, 1978), sample size adjusted BIC ($_{SSA}$BIC; Sclove, 1987), Bootstrapped Likelihood Ratio Test (BLRT; Arminger, Stein, & Wittenberg, 1999; McLachlan & Peel, 2000), Lo–Mendell–Rubin likelihood ratio test (LMR; Lo, Mendell, & Rubin, 2001), and entropy (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993).

AIC, BIC, and $_{SSA}$BIC are goodness of fit indices used for comparisons across competing models. Lower values indicate better-fitting models and extraction of latent classes should cease when these indices reach their lowest values. Recent simulation studies suggest that BIC is one of the most reliable indicators of the correct number of classes (Nylund et al., 2007). Of note, the above information criteria are based on the log likelihood function for individual models. The remaining two indicators used for class enumeration, i.e., LMR and BLRT, compare two log likelihood values and hence provide information about the improvement in fit between alternative solutions. A non-significant value ($p > .05$) for these indicators suggests that the model with one fewer class offers a more parsimonious fit to the data. Finally, entropy estimates how well each of the classes is separated and represented by the data based on the posterior class membership probabilities. These posterior probabilities are calculated using each participant's response pattern, the number of classes, and the proportion of participants in each group (Roesch et al., 2010). Values range from 0 to 1, with high values preferred. According to Ramaswamy et al. (1993), only entropy values greater than .80 are considered noteworthy.

Selection of the best-fitting model should also be based on whether the model reflects coherent, distinct, and conceptually meaningful subgroups and adequately explains the

heterogeneity in the sample. There are two model parameters which can facilitate decision-making in this regard: conditional response probabilities (CRP) in LCA or conditional response means (CRM) in LPA, as well as latent class probabilities (LCP). CRP value refers to the probability for an observed indicator to be present within a latent class, whereas CRM denotes the mean for an observed indicator within a latent profile (Roesch *et al.*, 2010). LCPs indicate most likely latent class membership and are comparable to factor scores (Lanza & Collins, 2008). Whilst groups characterized by small membership (less than 5%) are sometimes considered spurious (Hipp & Bauer, 2006), their stability should be assessed across studies utilizing diverse samples before discarding them as statistical anomalies.

Following identification of the best-fitting latent class/profile solution, additional analyses to determine correlations between the retrieved groups and covariates (whose selection must be guided by theory) ought to be performed to help describe the heterogeneity and substantiate the validity of the emergent subtypes. Muthén (2003, p. 373) suggests that, "The estimated prediction of class membership is a key feature in examining predictions of theory. If classes are not statistically different with respect to covariates that, according to theory, should distinguish classes, crucial support for the model is absent".

The current study

LCA/LPA studies are important within child maltreatment research because they can reveal the patterns of co-occurrence between different forms of CAN, as well as clarify associations between maltreatment classes and external criteria. Such research needs to be performed across a range of samples to verify whether CAN typologies vary for certain populations and replicated to confirm the retrieved subtypes (Roesch *et al.*, 2010). Although research employing LCA and LPA is still infrequently found within child abuse literature, application of the techniques has substantially increased in recent years. Consequently, the primary goal of this review is to provide a summary and critical evaluation of the findings of

LCA/LPA child maltreatment research conducted to date in order to: (*a*) systemize the current understanding of patterns of maltreatment across populations and (*b*) elucidate interactive effects of CAN types on psychosocial functioning. Based on the present study findings, we provide a set of recommendations for surpassing the current methodological and conceptual limitations in a bid to promote further knowledge development.

Method

Procedure

The planning, development, and reporting of findings has been guided by recommendations for systematic reviews in the field of health sciences provided by Perestelo-Pérez (2013). A search in PsychInfo, Eric, PubMed, Scopus, and Science Direct publication databases was performed in October 2016. Varying combinations of the following keywords were used to identify relevant articles: *child abuse, child abuse and neglect, CAN, neglect, childhood maltreatment, childhood adversity, maltreatment, abuse* AND at least one of the following terms: *latent class analysis, LCA, latent profile analysis, LPA, person-centered analysis, mixture modelling, profiling, profile, latent profile, class, latent class*. Upon considering that any use of such advanced analytical procedures would be detailed within an article abstract, database searches were limited to abstracts, keywords, and titles. Complimentary literature searches were also conducted in Google Scholar to ensure that all relevant publications had been found. Cited published research not generated in the search was also accessed. The initial search produced 198 references. All articles were added into the 4.0 Zotero reference management software whereby duplicates were eliminated ($N =$ 115). Preselection from study titles, abstracts, and keywords produced 27 references.

Selection process

Articles reviewed in the current study met the following selection criteria:

1. The study was an empirical piece of research examining CAN profiles among a variety of youth and adult populations. There were no restrictions regarding sample characteristics.

2. The study used LCA or LPA to retrieve CAN classes/profiles.

3. The study reported at least one goodness of fit statistic (AIC, BIC, or $_{SSA}$BIC), one class enumeration indicator (LMR or BLRT), and entropy.

4. Only studies in which classes/profiles were calculated using items pertaining to the following childhood maltreatment experiences were included: physical abuse, emotional abuse, sexual abuse (contact and non-contact), neglect (this could be specified as failure-to-provide, physical, emotional, or supervisory neglect), and exposure to domestic violence. Given the lack of international consensus on CAN definitions, measurement, and methodologies (Rumble *et al.*, 2017), specific definitions of CAN were not provided here and no restrictions as to the source of data were specified (e.g., self-report surveys, interviews, Child Protective Services [CPS]). Consequently, it was acknowledged that studies identified for analysis would differ considerably. However, to limit heterogeneity across manuscripts and ensure that meaningful comparisons are possible, studies which incorporated other childhood adversities (e.g., educational neglect, death of a parent, being involved in an accident) or any other additional variables (e.g., victimization experiences in adulthood, victim characteristics) in the LCA/LPA procedures were excluded.

5. Only studies in which LCA/LPA was performed on at least two CAN types listed above were included.

6. The study was written in English.

7. To guarantee high quality, only studies published in peer-reviewed journals were considered (excluding meeting abstracts, proceedings, master's and doctoral degree dissertations, technical reports, and similar documents).

Final selection of relevant publications was conducted by the study authors using the inclusion/exclusion criteria listed above. In order to eliminate the possibility of discrepancies in publications included for analysis, all authors independently reviewed pre-selected articles from the full text documents. Using this procedure, 16 relevant empirical studies were identified. Of these, nine inquired into CAN profiles among children and adolescents, four among mixed-gender adults, and three among exclusively male samples. The articles were published between 2008 and 2017 in nine different peer-reviewed journals.

Data extraction and analysis

Relevant information was extracted into a summary table. The following data from the studies were retrieved: author(s) and year of publication, study population and method of data collection, types of CAN measured, and CAN groups retrieved along with percentage of participants in each group (see Table 1). Due to the heterogeneity of selected studies with regard to maltreatment types assessed and methods applied, quantitative analysis of data was not feasible. Therefore, the results are presented as a narrative review, grouped into subsections based upon study population: children and adolescents, adult populations (mixed-gender samples), and exclusively male samples.

<div align="center">Results</div>

Children and adolescents

Nine of the reviewed studies assessed abuse experiences among children and adolescents (M age < 18 years; mixed-gender samples). To begin with, Nooner *et al*.'s (2010) research with 795 pre-adolescent youths from the United States (drawn from the LONGSCAN consortium), inquired into physical and sexual abuse experiences only. Based on $_{ssA}$BIC, LMR, and entropy values, the researchers identified four meaningful classes of abuse: no physical/sexual abuse (class 1; 85.1% of respondents), high physical and low sexual abuse (class 2; 6.2%), no physical abuse and moderate sexual abuse (class 3; 5.8%), as

well as high physical/sexual abuse (class 4; 2.9%) groups. Although some of the youth were recruited for the study due to reports of maltreatment, the high physical/sexual abuse group incorporated merely 2.9% of participants. Follow-up analyses demonstrated that the odds of a CPS report of maltreatment for Classes 2, 3, and 4 compared to Class 1 were significantly greater (2.21, 2.55, and 5.10, respectively), confirming the validity of the emergent classes based upon self-report data. Chi-square tests of significance did not reveal any significant differences between the classes on gender, ethnicity, or study location, which suggests an equal distribution of the retrieved abuse subtypes across sample subsets.

Villodas *et al*. (2012) also drew data from the LONGSCAN consortium, but in this study participants were profiled on a broader spectrum of abuse experiences (physical abuse, sexual abuse, failure-to-provide neglect, lack-of-supervision neglect, emotional maltreatment) and across three developmental periods (preschool, early, and late childhood). Unlike in Nooner *et al*.'s (2010) research where self-report data were used for CAN profiling, Villodas *et al*. (2012) analyzed the CPS records for instances of alleged maltreatment. Quite controversially, allegations were treated as indicators of experience to improve sensitivity. Analogous 3-class solutions were reported as the best model fit for preschool and early childhood. The groups in both analyses were termed low maltreatment, neglect/emotional maltreatment, and abuse/neglect/emotional maltreatment; suggesting low variations in maltreatment subtypes between those two early developmental stages. In late childhood, LCA yielded a 4-class solution. In addition to the three classes described above, a mixed maltreatment pattern representing a heterogeneous group of youth that had maltreatment allegations but no predominant pattern of subtypes emerged. Subsequent ANOVAs demonstrated that during preschool and early childhood, youth in the abuse/neglect/emotional maltreatment classes had significantly higher mean externalizing and total behavior (internalizing and externalizing) problems than youth in the low maltreatment classes. In late

childhood, youth in all three maltreatment classes had significantly higher mean externalizing and total behavior problems compared to members of the low maltreatment class.

Petrenko, Friend, Garrido, Taussig, and Culhane (2016) profiled respondents on physical and sexual abuse, physical and supervisory neglect; hence omitting experiences of emotional abuse (similarly to Nooner *et al*., 2010), which are sometimes regarded as the most difficult to define and measure (Cappelleri, Eckenrode, & Powers, 1993; McGee & Wolfe, 1991). LCA was conducted on data retrieved from 334 U.S. children placed in out-of-home care and yielded a 4-class model: supervisory neglect (class 1; 47%), physical neglect (class 2; 33%), physical abuse (class 3; 12%), and sexual abuse/mixed (class 4; 8%). Compared with children in class 1, those in class 2 had more internalizing problems, whereas those in class 3 had more externalizing problems.

Charak and Koot (2015), Hazen, Connelly, Roesch, Hough, and Landsverk (2009), as well as Pears, Kim, and Fisher (2008), focused on four types of maltreatment experiences, including physical abuse, emotional abuse, sexual abuse, and neglect; but there were variations across studies with regard to how neglect was defined. More specifically, Hazen *et al*. (2009) inquired into physical neglect, Charak and Koot (2015) modeled physical and emotional neglect as two separate variables, whereas Pears *et al*. (2008) were interested in supervisory neglect; which could partly explain the differences in the number of latent groups retrieved. For example, Pears *et al*. (2008) identified four profiles of CAN among 117 preschool children, all of whom were entering foster care placements and had a history of maltreatment. The profiles were termed: supervisory neglect/emotional maltreatment (n = 73; 62.39%), sexual abuse/emotional maltreatment/neglect (n = 14; 11.97%), physical abuse/emotional maltreatment/neglect (n = 19; 16.24%), sexual abuse/physical abuse/emotional maltreatment/neglect (n = 11; 9.4%). The best-fitting model was chosen based on BIC and entropy values. Although BLRT was found to be the only fit index

performing reasonably well with small sample sizes ($N < 200$; Nylund *et al*., 2007), this statistical indicator was not reported. The LMR value for the 4-profile model was non-significant ($p = .06$) and the exact LMR values were not reported. Based on a series of follow-up LCA nested models, the greatest risk of both externalizing and internalizing problems was reported for children in the sexual abuse/physical abuse/emotional maltreatment/neglect group; whereas the lowest risk of such problems was found for children classified in the supervisory neglect/emotional maltreatment group. A 4-class solution was also retrieved by Charak and Koot (2015) in a study among 702 adolescents from India; yet the classes differed in CAN types co-occurrence and membership size from prior research. The emergent classes were termed: moderate-severe abuse and physical neglect (class 1; 15.9%), low to moderate-severe abuse (class 2; 30.1%), moderate-severe neglect (class 3; 25.1%), and minimal abuse or neglect (class 4; 28.9%). Entropy value for the model was relatively low (.71), whereas 1- and 2-class models were not tested. Adolescents in classes 1 and 2 reported higher levels of personality pathology than the other classes. Finally, utilizing a sample of high-risk adolescents ($N = 1,131$), Hazen *et al*. (2009) retrieved three groups characterized by increased sexual, physical, and emotional maltreatment (profile 2; 8.7%), physical and emotional maltreatment (profile 3; 9.4%), and low maltreatment (profile 1; 81.9%). Males comprised 74.2% of profile 1, 12.9% of profile 2, and 58.4% of profile 3; indicating that females were more likely to report experiences of sexual abuse. Although both AIC and BIC values were lower for 4-, 5-, and 6-class solutions and entropy was higher for the 4-class model, the models did not differ significantly from the 3-class solution (as evidenced by non-significant LMR values) and so the most parsimonious model was adopted. Youths in profiles 2 and 3, compared with those in profile 1, were significantly more withdrawn and anxious/depressed, made more somatic complaints, and evidenced more aggressive behaviors as well as social and thought problems.

More recently and utilizing the largest sample of youngsters so far (N = 3,706), Clarke *et al*. (2016) explored patterns of physical, emotional, and sexual violence perpetrated by adults (parents, non-parent relatives, school staff) and peers against Ugandan children. The results yielded a 3-class solution, incorporating class 1 characterized by emotional and physical violence by relatives, and sexual and emotional abuse by girlfriends, boyfriends, and unrelated adults (18.8%); class 2 with increased probability of exposure to physical, emotional, and sexual violence by peers (26.3%); and class 3 characterized by physical violence by school staff (54.9%). Nonetheless, this solution evidenced a poor entropy value (.602), whereas $_{SSA}$BIC values were lower for competing 4-, 5-, and 6-class models (LMR for those solutions was non-significant). Children in classes 1 and 2 had more mental health difficulties than those in class 3. Female participants were most likely to belong in class 1.

Only one study with youth samples included in this review (Lin *et al*., 2016), did *not* inquire into sexual abuse, which could be due to methods applied (parent-reported) and the nature of the sample (256 Chinese children with Oppositional Defiant Disorder [ODD]). Indeed, earlier research among Chinese societies indicated that parents' reports are unlikely to reveal the true prevalence of child sexual abuse (Chan, 2005, 2008). Lin *et al*.'s (2016) focus, hence, was on physical abuse, emotional abuse, and emotional neglect. In this study, three profiles termed: low maltreatment (profile 1; 64.06%), medium maltreatment (profile 2; 23.83%), and high maltreatment (profile 3; 12.11%) were retrieved. As indicated by the group labels, differences between the profiles were largely quantitative. Follow-up analyses revealed that children from profile 1 had significantly better parent-child, teacher-student, and peer relationships than their counterparts in profiles 2 and 3; demonstrating an important association between maltreatment and children's social interactions across different contexts.

Lastly, Witt *et al*. (2016), looking at the broadest spectrum of abuse experiences to date (sexual abuse in general, sexual abuse with penetration, physical abuse, emotional abuse,

neglect, and exposure to domestic violence), aimed to identify meaningful classes of

maltreatment among 358 German children and adolescents. Based on LCA results,

participants were categorized into three classes: multi-type maltreatment except sexual abuse

(class 1; 63.1%), multi-type maltreatment including sexual abuse (class 2; 26.5%), and

predominantly sexual abuse (class 3; 10.3%). Given the specificity of the sample (all

participants had a known history of maltreatment), the lack of a low maltreatment group was

unsurprising. Females, compared with males, were more likely to belong in classes 2 and 3,

i.e., those in which sexual abuse was featured. Youth in class 2 evidenced lower psychosocial

functioning and had a significantly higher mean number of mental health diagnoses than

members of the remaining groups, indicating that exposure to multiple types of maltreatment

is associated with most adverse outcomes.

Adult populations (mixed-gender samples)

Four of the reviewed studies employed adult mixed-gender populations. Berzenski

and Yates (2011) evaluated maltreatment patterns among U.S. undergraduate students for the

full sample ($N = 2,637$), participants who endorsed any type of maltreatment ($n = 1,129$), and

participants who endorsed more than one type of maltreatment ($n = 431$). A 2-class solution

was selected as the best-fitting model for the total sample (based on AIC, BIC, and LMR).

The entropy value, however, was poor for the 2-class model (.494) and all remaining

solutions (with the highest value for the 4-class model: .726). The two classes identified were

labelled 'no maltreatment' (79.9%) and 'maltreatment' (20.1%), suggesting quantitative but

not qualitative differences between the groups. Among the maltreated sample, 4 classes were

distinguished, but they corresponded to individual maltreatment types, rather than patterns of

co-occurrences between them: physical abuse (31%), emotional abuse (16%), domestic

violence (33.6%), and sexual abuse (19.4%). Four maltreatment subtypes were also identified

for the multiply maltreated students: violent home (class 1; 16.5%), hostile home (class 2;

13.2%), harsh parenting (class 3; 20.4%), sexual abuse (class 4; 49.9%). Validation of latent classes was undertaken for the final subsample only. Emotional abuse, alone or in combination with other maltreatment types (classes 2 and 3), was especially salient for psychopathology (e.g., anxiety and depression). A combination of physical and emotional abuse (class 3) was most strongly associated with conduct-related problems (e.g., substance use and risky sexual behavior).

Vaughn, Salas-Wright, Underwood, and Gochez-Kerr's (2015) study is yet another investigation in which exposure to family violence was incorporated in the analysis, alongside sexual abuse, physical abuse, and parental neglect. The study sample was restricted to adults reporting ever having engaged in non-suicidal self-injury (NSSI). Results suggested a 4-class solution. Class 1 (low abuse/neglect; 35.57%) was characterized by individuals reporting very low levels of any abuse type and family violence. Individuals in class 2 (sexual abuse; 43.15%) reported elevated levels of sexual abuse, with relatively low levels of physical abuse, parental neglect, and family violence. Class 3 (non-sexual abuse/neglect; 8.33%) had elevated levels of physical abuse, parental neglect, and family violence. Individuals in class 4 (high abuse/neglect and family violence; 12.95%) experienced adverse childhood events in all four of the domains examined. Entropy value for the solution was relatively low (.77). Of note, two classes characterized by increased levels of sexual abuse (classes 2 and 4) incorporated predominantly (98.59% for class 2) or exclusively (class 4) female participants. Further, members of class 4 reported the highest levels of clinical and personality disorders. The highest rates of substance use disorders as well as criminal and violent behavior were observed among members of class 3.

Armour, Elklit, and Christoffersen (2014) performed an LCA on physical abuse, psychological maltreatment, neglect, and sexual abuse. The sample consisted of a stratified random sample of 2,980 Danes. Four latent typologies were identified: psychologically

maltreated class (class 1; 9.7%), sexually abused class (class 2; 2%), abused overall class (class 3; 2.1%), and non-abused class (class 4; 86.2%). The suitability of this model was confirmed by the lowest BIC value (AIC and $_{SSA}$BIC values were slightly lower for 5- and 6-class solutions, whereas entropy was slightly higher for the 3-class model). LMR values for all tested solutions were statistically non-significant. Further, classes 2 and 3 were characterized by membership which falls below the critical value of 5%. The profile plot of the maltreatment items demonstrated that the subtypes differed most prominently on abuse intensity (quantitative differences) rather than variations of co-occurrence of abuse types (qualitative differences); with the exception of class 2, whose members scored extremely high on sexual abuse items and very low on the remaining abuse items. Subsequent analyses validating the latent class model established that, compared with class 4, members of classes 1, 2, and 3 were significantly more likely to have had a child protection status. Being a female significantly increased the odds of being grouped in class 2 (i.e., a class with heightened sexual abuse) than class 4, which is congruent with other studies reviewed here (Charak & Koot, 2015; Vaughn *et al*., 2015; Witt *et al*., 2016).

The lack of qualitative differences between emergent CAN subtypes features in yet another study among male and female adolescents and young adults from the UK (N = 204; M age = 18.85). More specifically, Cecil, Viding, Barker, Guiney, and McCrory (2014) found three profiles of CAN: low maltreatment (class 1; 58%), moderate maltreatment (class 2; 30%), severe maltreatment (class 3; 12%). Fit indices for the model are not provided in the publication but are available online ($_{SSA}$BIC, LMR, and entropy). Follow-up regression analyses demonstrated that the low maltreatment group experienced significantly less internalizing (compared with class 3) and externalizing problems (compared with class 2 and 3). The moderate maltreatment group had significantly lower scores on internalizing

difficulties than the severe maltreatment group. Other significant differences between the subtypes were found for trauma-related symptoms.

Exclusively male samples

Three studies included in the review were conducted with exclusively male samples, two of which were criminal justice involved. Davis *et al*. (2015) identified four latent subtypes of childhood maltreatment among 626 urban community males: low maltreatment (80%), emotional and physical maltreatment (12%), emotional and sexual maltreatment (4%), as well as poly-victimized (4%). As indicated, two classes were characterized by small membership (< 5%). Although the reported goodness of fit indices (AIC and $_{SSA}$BIC) were lower for the 5- and 6-class solutions, LMR values for those two models were non-significant and the additional latent classes were small and not conceptually distinct from those contained within the 4-class model. Subsequent analysis established that the emotional and physical maltreatment group had significantly higher intimate partner violence (IPV) perpetration rates than the low maltreatment group. Men in the poly-victimized class, in comparison to their low maltreatment counterparts, scored lower on income and education level, as well as higher on incarceration history and recent anxiety/depression symptoms.

Two studies (Aebi *et al*., 2015; Debowska & Boduszek, 2017) profiled CAN among criminal populations. To begin with, Aebi *et al*. (2015) assessed childhood emotional, physical, and sexual maltreatment in a sample of 260 Austrian detained male adolescent offenders. LCA yielded a 3-class solution: no/mild trauma (class 1; 76%); emotional and physical trauma (class 2; 18%); emotional, physical, and sexual trauma (class 3; 8%). The 3-class model evidenced the lowest AIC value. The BIC value was slightly lower and entropy slightly higher for 4-, 5-, and 6-class solutions. Other fit indices were not reported. Compared with class 1, classes 2 and 3 were associated with ADHD, affective and anxiety disorders, and suicidality; whereas members of class 3 had higher recidivism rates.

The focus of Debowska and Boduszek's (2017) study was on creating CAN profiles within a systematically selected sample of Polish adult prisoners ($N = 1,261$). The researchers assessed the patterns of co-occurrence between childhood physical abuse, emotional abuse, contact sexual abuse, penetrative sexual abuse, and neglect. Based on all fit statistics (AIC, BIC, $_{SSA}$BIC, BLRT, LMR, and entropy), three unique classes of CAN were distinguished, including a low abuse group (class 3), a high physical and emotional abuse group (class 2), and a poly-victimized group (class 1). Contrary to authors' initial predictions, the most numerous group was not the one characterized by low/lack of maltreatment (43.4% of the sample). Rather, participating inmates were most likely to belong in the high physical and emotional abuse subtype (51.3%), which is congruent with earlier studies indicating an increased rates of child maltreatment among offenders than among community-based populations (e.g., Williams *et al*., 2012). Subsequent analyses revealed that prisoners in class 2, compared with those in class 3, scored lower on personal and prison-specific self-esteem, had fewer deficits in cognitive responsiveness (psychopathy dimension of the Psychopathic Personality Traits Scale [PPTS], Boduszek, Debowska, Dhingra, & DeLisi, 2016), and were more likely to have engaged in violent offending. With merely 5.3% of participants, the poly-victimized class was the smallest in the study. It was distinguished from the low abuse class by lower personal self-esteem levels and increased odds of violent offending. Poly-victimized inmates evidenced greater deficits in cognitive responsiveness and lower deficits in affective responsiveness in comparison with members of class 2.

Table 1.

Methodological Characteristics and Summary Results of the Studies Included in the Systematic Review (N = 16)

Author(s) and year of publication	Study population and method of data collection	Types of CAN measured	CAN groups retrieved (percentage of participants)
*Aebi *et al*. (2015)	260 detained male adolescent offenders from Austria (*M* age = 16.5 years) – self-report	Physical abuse, emotional abuse, sexual abuse	**3 classes:** no/mild trauma (76%); emotional & physical trauma (18%); emotional, physical, & sexual trauma (8%)
*Armour *et al*. (2014)	2980 mixed-gender adult Danes (all aged 24 years) - interview	Physical abuse, psychological abuse, sexual abuse, neglect	**4 classes:** psychologically maltreated class (9.7%); sexually abused class (2%); abused overall class (2.1%); non-abused class (86.2%)
*Berzenski & Yates (2011)	2637 U.S. undergraduate students (64% female; *M* age = 19.10 years) – self-report	Physical abuse, emotional abuse, sexual abuse, exposure to domestic violence	**(1) Full sample (*n* = 1129) - 2 classes:** no maltreatment (79.9%); maltreatment (20.1%); **(2) Maltreated sample (*n* = 431) – 4 classes:** physical abuse (31%); emotional abuse (16%); domestic violence (33.6%); sexual abuse (19.4%); **(3) Multiply maltreated sample – 4 classes:** violent home (16.5%); hostile home (13.2%); harsh parenting (20.4%); sexual abuse (49.9%)
[+]Cecil *et al*. (2014)	204 UK adolescents and young adults (54% females; aged 16-24 years, *M* = 18.85 years) – self-report	Physical abuse, emotional abuse, sexual abuse, emotional neglect, physical neglect	**3 profiles:** low maltreatment (58%); moderate maltreatment (30%); severe maltreatment (12%)
*Charak & Koot (2015)	702 adolescents from India (41.5% females; 13-17 years old, *M* = 15.24) – self-report	Physical abuse, emotional abuse, sexual abuse, emotional neglect, physical neglect	**4 classes:** moderate-severe abuse & physical neglect (15.9%); low to moderate-severe abuse (30.1%); moderate-severe neglect (25.1%); minimal abuse or neglect (28.9%)
*Clarke *et al*. (2016)	3706 primary school children from Uganda (52.3% females; aged 7-18 years, *M* = 13) - interview	Emotional violence, physical violence, sexual violence (by parents, non-parent relatives, school staff, peers, and others)	**3 classes:** emotional & physical violence by relatives, and sexual & emotional abuse by girlfriends, boyfriends, and unrelated adults (18.8%); exposure to physical, emotional, and sexual violence by peers (26.3%); physical violence by school staff (54.9%)
*Davis *et al*. (2015)	626 U.S. urban community males (aged 21-30 years, *M* = 24.6 years) – self-report	Emotional abuse, physical abuse, sexual abuse, emotional neglect, physical neglect	**4 classes:** low maltreatment (80%); emotional & physical maltreatment (12%); emotional & sexual maltreatment (4%); poly-victimized (4%)

*Debowska & Boduszek (2017)	1261 Polish adult male prisoners (*M* age = 34.90 years) – self-report	physical abuse; emotional abuse; sexual abuse – touch; sexual abuse – penetration; neglect	**3 classes:** low abuse (43.3%); high physical and emotional abuse (51.3%); poly-victimized (5.3%)
[+]Hazen *et al*. (2009)	1131 adolescents (aged 12-18 years, M = 15.53; 66% males) involved with mental health & social services in California – interview with participants & their caregivers	Physical abuse, sexual abuse, emotional abuse, physical neglect, emotional neglect	**3 profiles:** sexual, physical & emotional maltreatment (8.7%); physical & emotional maltreatment (9.4%); low maltreatment (81.9%)
[+]Lin *et al*. (2016)	256 elementary school children with ODD from China (*M* age = 9.56 years; 71.9% males) – self-report (parents)	Emotional neglect, emotional abuse, physical abuse	**3 profiles:** low maltreatment (64.06%); medium maltreatment (23.83%); high maltreatment (12.11%)
*Nooner *et al*. (2010)	795 pre-adolescent youths (aged 11-13 years, *M* = 12.1; 395 males and 400 females; drawn from the LONGSCAN consortium - self-report)	Physical abuse, sexual abuse	**4 classes:** no physical/sexual abuse (85.1%); high physical & low sexual abuse (6.2%); no physical & moderate sexual abuse (5.8%); high physical/sexual abuse (2.9%)
[+]Pears *et al*. (2008)	117 maltreated foster children (3-6 years old; 63 males) from the Pacific Northwest - Child welfare system case records	Physical abuse, emotional maltreatment, sexual abuse, supervisory neglect	**4 profiles:** supervisory neglect/emotional maltreatment (62.39%); sexual abuse/emotional maltreatment/neglect (11.97%); physical abuse/emotional maltreatment/neglect (16.24%); sexual abuse/physical abuse/emotional maltreatment/neglect (9.4%)
*Petrenko *et al*. (2016)	334 U.S. children (9-11 years old, M = 10.30; 48.5% females) placed in out-of-home care – interview with children & caregivers	Physical abuse, sexual abuse, physical neglect, supervisory neglect	**4 classes:** supervisory neglect (47%); physical neglect (33%); physical abuse (12%); sexual abuse/mixed (8%)
*Vaughn *et al*. (2015)	672 U.S. adults engaging in NSSI (drawn from the Wave II of the NESARC - interview)	Sexual abuse, physical abuse, parental neglect, family violence	**4 classes:** low abuse/neglect (35.57%); sexual abuse (43.15%); non-sexual abuse/neglect (8.33%); high abuse/neglect & family violence (12.95%)
*Villodas *et al*. (2012)	788 pre-adolescent youths (aged 11-13 years, *M* = 12.1; 395 males and 400 females; drawn from the LONGSCAN consortium – CPS records)	Physical abuse, sexual abuse, failure-to-provide neglect, lack-of-supervision neglect, emotional maltreatment	**(1) Preschool - 3 classes:** low maltreatment (69%); neglect/emotional maltreatment (15%); abuse/neglect/emotional maltreatment (16%); **(2) Early childhood - 3 classes:** low maltreatment (73%); neglect/emotional maltreatment (10%); abuse/neglect/emotional maltreatment (17%); **(3) Late childhood - 4 classes:** low maltreatment (81%); mixed maltreatment (8%); physical/emotional abuse (3%); abuse/neglect/emotional maltreatment (8%)

*Witt *et al.* (2016)	358 German children and adolescents (aged 4-17 years, *M* = 10.18; 56.8% males) with a known history of child maltreatment – interview & questionnaires with participants & their caregivers	Sexual abuse in general, sexual abuse with penetration, physical abuse, emotional abuse, neglect, exposure to domestic violence	**3 classes:** multi-type maltreatment excluding sexual abuse (63.1%); multi-type maltreatment including sexual abuse (26.5%); predominantly sexual abuse (10.3%)

Note. * = Studies which employed LCA; [+] = Studies which employed LPA; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; BLRT = Bootstrapped Likelihood Ratio Test; CAIC = Consistent Akaike Information Criterion; CPS = Child Protective Services; LCA = Latent class analysis; LMR = Lo–Mendell–Rubin likelihood ratio test; NESARC = National Epidemiologic Survey on Alcohol and Related Conditions; NSSI = Non-suicidal self-injury; ODD = Oppositional Defiant Disorder; $_{SSA}$BIC = sample size adjusted BIC.

Discussion

It is widely acknowledged that the prevalence and coincidence of different forms of CAN are not universal across societies (WHO, 2016). Thus, studies elucidating patterns of maltreatment and their psychosocial consequences across the life course among a variety of populations are crucial for designing population-level intervention and prevention strategies reducing the risk and alleviating negative consequences of CAN (Sanders, Cann, & Markie-Dadds, 2003). In considering the importance of profiling research to child protection, the objective of the present paper was to provide a summary and critical evaluation of the findings of LCA/LPA studies assessing co-occurrence between CAN types. We conclude with recommendations for future scholarship.

Of the 16 studies reviewed here, one has identified 2 meaningful classes of CAN, eight studies reported a 3-class solution, and nine studies retrieved 4 classes as the best model fit. Two studies conducted analyses on more than one sample and revealed varying best solutions. These inconsistent findings may be partly explained by the differences in samples utilized, cultural variations, and types of CAN included in the analysis. Indeed, the reviewed investigations differed with regard to maltreatment forms examined. Two studies profiled respondents on physical, emotional, and sexual abuse only (Aebi *et al*., 2015; Clarke *et al*., 2016). Although both reported the superiority of a 3-class solution, the groups retrieved were not analogous. Further, eight studies inquired into physical abuse, emotional abuse, sexual abuse, and neglect (Armour *et al*., 2014; Cecil *et al*., 2014; Charak & Koot, 2015; Davis *et al*., 2015; Debowska & Boduszek, 2017; Hazen *et al*., 2009; Pears *et al*., 2008; Villodas *et al*., 2016); yet no agreement as to the number of groups was reached. Direct comparisons between these studies are further complicated by conceptual variations. More specifically, sexual abuse was included as a single variable in the majority of the above research, but Debowska and Boduszek (2017) modeled contact and penetrative sexual abuse separately.

Most discrepancies, however, related to defining neglect, with some researchers being interested in its very specific expressions, such as failure-to-provide (Villodas *et al.*, 2012), supervisory (Pears *et al.*, 2008; Petrenko *et al.*, 2016; Villodas *et al.*, 2012), emotional (Cecil *et al.*, 2014; Davis *et al.*, 2015; Hazen *et al.*, 2009), and physical (Cecil *et al.*, 2014; Chark & Koot, 2015; Davis *et al.*, 2015; Hazen *et al.*, 2009; Petrenko *et al.*, 2016) neglect. Importantly, the number of CAN classes identified did not seem to be a function of data collection strategy (e.g, self-report, interviews with caregivers, CPS reported cases).

More similarities between the studies can be found upon perusal of the qualitative properties of the latent subtypes recovered. For instance, 12 investigations found a latent class characterized by low endorsement on all maltreatment types (Aebi *et al.*, 2015; Armour *et al.*, 2014; Berzenski & Yates, 2011; Cecil *et al.*, 2014; Charak & Koot, 2015; Davis *et al.*, 2015; Debowska & Boduszek, 2017; Hazen *et al.*, 2009; Lin *et al.*, 2016; Nooner *et al.*, 2010; Vaughn *et al.*, 2015; Villodas *et al.*, 2012). In nine of those studies, this was the most numerous class, with membership ranging from 58 to 86.2 per cent (Aebi *et al.*, 2015; Armour *et al.*, 2014; Berzenski & Yates, 2011; Cecil *et al.*, 2014; Davis *et al.*, 2015; Hazen *et al.*, 2009; Lin *et al.*, 2016; Nooner *et al.*, 2010; Villodas *et al.*, 2012). This indicates that most individuals do not experience CAN – a finding consistent across cultures and societies. Members of no/low abuse classes were also reported to be the least likely to suffer from adverse psychosocial outcomes. Moreover, though Debowska and Boduszek (2017) classed the biggest proportion of participants in a group characterized by increased physical and emotional abuse (51.3%), whereas Vaughn *et al.* (2015) found sexual abuse class to be the largest (43.15%), this may be due to the samples employed (prisoners and adults engaging in NSSI respectively). The increased number participants in the latent classes identified in the two studies (i.e., high physical and emotional abuse class [Debowska & Boduszek, 2017] and sexual abuse class [Vaughn *et al.*, 2015]) demonstrates how certain patterns of abuse may

instigate specific externalizing (offending) or internalizing (NSSI) problems. To corroborate, other research reviewed here in which high physical and emotional abuse pattern was retrieved, suggested that this latent class predicts poor behavioral outcomes and conduct-related problems, including aggressive behavior, risky sexual behavior, and IPV perpetration (Berzenski & Yates, 2011; Davis *et al*., 2015; Hazen *et al*., 2009; Villodas *et al*., 2012).

Another CAN subtype which re-emerged across studies is the one characterized by poly-victimization (Aebi *et al*., 2015; Armour *et al*., 2014; Cecil *et al*., 2014; Davis *et al*., 2015; Debowska & Boduszek, 2017; Hazen *et al*., 2009; Lin *et al*., 2016; Nooner *et al*., 2010; Pears *et al*., 2008; Petrenko *et al*., 2016; Vaughn *et al*., 2015; Villodas *et al.*, 2012; Witt *et al*., 2016). This was usually the least numerous group (2.1% - 26.5%), with high rates of multiple victimization found predominantly in studies among participants with a known history of childhood maltreatment (e.g., Pears *et al*., 2008; Villodas *et al*., 2012; Witt *et al*., 2016) or other high-risk populations (e.g., Vaughn *et al*., 2015). Furthermore, whilst classes characterized by small membership (less than 5%) are sometimes regarded as spurious (Hipp & Bauer, 2006), the stability of a poly-victimized subtype across studies suggests that it should not be interpreted as a statistical anomaly. Of note, poly-victimization was associated with the most adverse consequences, both internalizing (e.g., depression, anxiety, personality disorder) and externalizing (e.g., aggression, violent offending, recidivism), in all studies. Interestingly, although some early reviews presented child sexual abuse as a strong predictor of adverse psychiatric outcomes (Browne & Finkelhor, 1986; Kendall-Tackett *et al*., 1993; Polusny & Follette, 1995), the present findings indicate that the negative effect of sexual abuse is significantly augmented if it occurs in conjunction with other maltreatment types (e.g., see Vaughn *et al*., 2015). In line with research evidence that most perpetrators of CAN are parents (Gilbert *et al*., 2009), it may also be that individuals subject to multiple victimization are likely to experience maltreatment intrafamilially, rather than outside the

home. This in turn can instigate the feeling of powerlessness and betrayal (Finkelhor & Browne, 1985), which may moderate the relationship between abuse and health outcomes. Although one study reviewed here reported more mental health difficulties among children abused by relatives and peers than those maltreated by school staff (Clarke *et al.*, 2016), more research in which respondents are profiled on CAN by perpetrator type and/or victimization setting is warranted to understand how the nature of the victim-perpetrator relationship might affect health and social wellbeing of the abused.

Four reviewed studies recovered a latent class characterized by high endorsement of sexual abuse and low endorsement of other maltreatment forms (Armour *et al.*, 2014; Berzenski & Yates, 2011; Vaughn *et al.*, 2015; Witt *et al.*, 2016). Notably, Armour *et al.*, (2014), Vaughn *et al.* (2015), and Witt *et al.* (2016) established that being a female significantly increases the odds of being a member of such a class, which is in line with prior statistical evidence suggesting higher incidence of sexual victimization among females than males (Al-Fayez *et al.*, 2012; Cappelleri *et al.*, 1993; Finkelhor *et al.*, 1990; WHO, 2016). Moreover, a CAN subtype characterized by sexual abuse only was absent in studies utilizing exclusively male samples, indicating that the two genders experience abuse differently and hence their maltreatment profiles can also vary. Profiling research with exclusively female populations, however, is needed to corroborate this supposition.

Even though research into CAN coincidence can enable risk identification and development of preventive measures, studies applying advanced statistical methods may be difficult to interpret for individuals working in applied settings; hence limiting their usefulness for practice. As such, it is advisable that CAN profiling research is reported in a clear and accessible manner, and that a visual representation of findings is always included. Indeed, in addition to facilitating the interpretation of results, a profile plot of abuse items provides further insight into quantitative and qualitative differences between retrieved

classes. Of the 16 reviewed studies, however, only nine have provided such output (Aebi *et al.*, 2015; Armour *et al.*, 2014; Cecil *et al.*, 2014; Debowska & Boduszek, 2017; Lin *et al.*, 2016; Nooner *et al.*, 2010; Vaughn *et al.*, 2015; Villodas *et al.*, 2012; Witt *et al.*, 2016). Further, interpretation of findings may also be hindered by class labels which do not reflect participants' endorsement of different maltreatment types. For example, a class characterized by emotional and physical abuse, with a small likelihood of domestic violence, and no chance of sexual abuse in Berzenski and Yates' (2011) study was termed 'harsh parenting'. Finally, there is a need for an agreement on how various CAN types should be conceptualized and assessed to enable more meaningful comparisons between studies (see Leeb, Paulozzi, Melanson, Simon, & Arias, 2008 for suggested definitions).

Recommendations

In consideration of the above-presented inconsistencies regarding methods applied and reporting of findings, as well as gaps in the literature, we provide a set of recommendations which will systemize future research (1-8) and expand our current understanding of CAN patterns and associated consequences (9-14):

1. Given that no consensus as to the number and nature of latent CAN groups in a population has been established, profiling research should continue to use exploratory rather than confirmatory LCA and LPA (see Finch & Bronk, 2011; Laudy *et al.*, 2007).

2. As for the number of models tested, we recommend to estimate a sequence of models with two classes through to six classes as a minimum, unless an appropriate model fit is identified earlier.

3. Choosing the best model fit is a judgement call. To render the process of class enumeration more objective and scientific, model selection should be based on parsimony considerations (simpler models are preferred if represent the data adequately), interpretability (a useful statistical model is readily interpretable; each class should be

distinguishable from the others on the basis of the CRP/CRM), and statistical criteria

(lower AIC, BIC, and $_{SSA}$BIC values are preferred; LMR and BLRT should be significant;

entropy value should be greater than .80) (Collins & Lanza, 2010; Lanza, Collins,

Lemmon, & Schafer, 2007; Ramaswamy *et al*., 1993). If available, all listed statistical

indices ought to be reported (and not only the associated *p*-value).

4. BIC is one of the most reliable indicators of the correct number of classes. If discrepancies

    between AIC and BIC values emerge, the latter index should be favored (Nylund *et al*.,

    2007).

5. If fit indices for all models suggest a poor fit to the data, interpretability and parsimony

    should guide initial model selection. However, in such cases a replication study is needed

    to enable cross-validation (a statistical approach to establishing whether an estimated

    model is generalizable to other data sets) (see Collins & Lanza, 2010).

6. When a small sample size is used ($N < 200$), the BLRT value (i.e., the only fit index

    performing reasonably well with small sample sizes [Nylund *et al*., 2007]) should be

    reported (for more information on how to decide on sample size and determine power,

    please see Muthén & Muthén, 2002).

7. Research findings should be accompanied by a profile plot of abuse items, which will

    highlight the nature of differences (quantitative vs. qualitative) between latent classes.

8. Class labels should be clear, reflective of endorsement of different CAN forms, and as

    concise as possible.

9. To date, there is no international consensus on the definition of child maltreatment

    (Rumble *et al*., 2017), which is partly affected by differing laws and legal frameworks

    (e.g., definitions of physical abuse may depend on whether or not corporal punishment is

    outlawed in a given country). To enable more meaningful comparisons between studies

    and facilitate communication between sectors, it is of paramount importance that abuse is

clearly defined in all published manuscripts. A more challenging long-term goal is to establish definitions of CAN which would be consistent across cultures and sectors (e.g., CPS, legal and medical communities, researchers) (see Leeb *et al*., 2008).

10. In considering that CAN profiles may vary across age groups, future research should control for development periods in which maltreatment first occurred.

11. There is a need for studies profiling various CAN types by perpetrator and victimization setting. This would enable more efficient identification of offenders, who could then be targeted for a more focused prevention/intervention.

12. Research should aim to compare maltreatment patterns between the two sexes. To date, however, there is a lack of studies among exclusively female samples.

13. Twelve presented studies were conducted among Western populations, including eight with participants drawn from the United States. More research within non-Western societies is needed to build a better understanding of CAN co-occurrence worldwide.

14. The reviewed research assessed the presence of internalizing and externalizing symptomatology as a function of different CAN patterns. Possible outcomes which require future attention include CAN perpetration, adult victimization, serious offending, decreased empathy, panic reactions, impaired memory of childhood, sleep disturbance, sexual dissatisfaction, severe obesity, and physical health conditions.

Conclusions and limitations

Based on 16 articles published in peer-reviewed journals, we provided a summary and critical evaluation of CAN profiling research conducted to date. As such, the current systematic review constitutes a contribution to the knowledge of (*a*) CAN co-occurrence patterns among youth and adult samples and (*b*) how different abuse permutations associate with external criteria, including internalizing and externalizing problems. It is envisaged that evidence presented herein will serve as a basis for the design of appropriate preventive and

treatment strategies. From the research perspective, we have provided a set of recommendations which should guide future CAN profiling investigations.

The present study, however, should be interpreted in light of several limitations. Firstly, the search was limited to paper titles, abstracts, and keywords. Although most of the reviewed studies have made it explicit in the title that a person-oriented technique was employed and we expected that this would be acknowledged in at least the study abstract, this did not have to be the case with all research. Secondly, only articles published in peer-reviewed journals were considered. Thus, it may be that the results are affected to some extent by publication bias or the tendency of journals to publish work which reports significant results (Perestelo-Pérez, 2013). Lastly, we only analyzed articles published in English, would could have resulted in having omitted some important studies among non-English speaking samples.

References

Aebi, M., Linhart, S., Thun-Hohenstein, L., Bessler, C., Steinhausen, H. C., & Plattner, B. (2015). Detained male adolescent offender's emotional, physical and sexual maltreatment profiles and their associations to psychiatric disorders and criminal behaviors. *Journal of Abnormal Child Psychology, 43*(5), 999-1009. doi: 10.1007/s10802-014-9961-y

Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control*, *19*(6), 716-723. doi: 10.1109/TAC.1974.1100705

Al-Fayez, G. A., Ohaeri, J. U., & Gado, O. M. (2012). Prevalence of physical, psychological, and sexual abuse among a nationwide sample of Arab high school students: association with family characteristics, anxiety, depression, self-esteem, and quality of life. *Social Psychiatry and Psychiatric Epidemiology*, *47*(1), 53-66. doi: 10.1007/s00127-010-0311-2

Arminger, G., Stein, P., & Wittenberg, J. (1999). Mixtures of conditional mean-and covariance-structure models. *Psychometrika*, *64*(4), 475-494. doi: 10.1007/BF02294568

Armour, C., Elklit, A., & Christoffersen, M. N. (2014). A latent class analysis of childhood maltreatment: Identifying abuse typologies. *Journal of Loss and Trauma*, *19*(1), 23-39. doi: 10.1080/15325024.2012.734205

Berzenski, S. R., & Yates, T. M. (2011). Classes and consequences of multiple maltreatment: A person-centered analysis. *Child Maltreatment*, *16*(4), 250-261. doi: 10.1177/1077559511428353

Boduszek, D., Debowska, A., Dhingra, K., & DeLisi, M. (2016). Introduction and validation of the Psychopathic Personality Traits Scale (PPTS) in a large prison sample. *Journal of Criminal Justice, 46*, 9-17. doi: 10.1016/j.jcrimjus.2016.02.004

Boduszek, D., Hyland, P., & Bourke, A. (2012). An Investigation of the role of personality, familial and peer-related characteristics in homicidal offending using retrospective data. *Journal of Criminal Psychology, 2*(2), 96-106. doi: 10.1108/20093821211264414

Browne, A., & Finkelhor, D. (1986). Impact of child sexual abuse: A review of the research. *Psychological Bulletin*, *99*(1), 66-77.

Cappelleri, J. C., Eckenrode, J., & Powers, J. L. (1993). The epidemiology of child abuse: Findings from the Second National Incidence and Prevalence Study of Child Abuse

and Neglect. *American Journal of Public Health*, *83*(11), 1622-1624. doi: 10.2105/AJPH.83.11.1622

Cecil, C. A., Viding, E., Barker, E. D., Guiney, J., & McCrory, E. J. (2014). Double disadvantage: The influence of childhood maltreatment and community violence exposure on adolescent mental health. *Journal of Child Psychology and Psychiatry*, *55*(7), 839-848. doi: 10.1111/jcpp.12213

Chan, K. L. (2005). *Study on child abuse and spouse battering: Report on findings of household survey [A Consultancy Study Commissioned by the SWD of the HKSAR]*. Hong Kong: Department of Social Work & Social Administration, the University of Hong Kong.

Chan, K. L. (2008). Sexual violence against women and children in Chinese societies. *Trauma, Violence, & Abuse, 10*(1), 69-85. doi: 10.1177/1524838008327260

Charak, R., & Koot, H. M. (2015). Severity of maltreatment and personality pathology in adolescents of Jammu, India: A latent class approach. *Child abuse & Neglect*, *50*, 56-66. http://dx.doi.org/10.1016/j.chiabu.2015.05.010

Clarke, K., Patalay, P., Allen, E., Knight, L., Naker, D., & Devries, K. (2016). Patterns and predictors of violence against children in Uganda: a latent class analysis. *BMJ open*, *6*(5), e010443. doi: 10.1136/bmjopen-2015-010443

Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis: With applications in the social, behavioural, and health sciences*. New York, NY: Wiley.

Davis, K. C., Masters, N. T., Casey, E., Kajumulo, K. F., Norris, J., & George, W. H. (2015). How childhood maltreatment profiles of male victims predict adult perpetration and psychosocial functioning. *Journal of Interpersonal Violence*. doi: 10.1177/0886260515613345

Debowska, A., & Boduszek, D. (2017). Child abuse and neglect profiles and their psychosocial consequences in a large sample of incarcerated males. *Child Abuse & Neglect, 65,* 266-277. doi: 10.1016/j.chiabu.2016.12.003

De Fruyt, F., & De Clercq, B.(2014).Antecedents of personality disorder in childhood and adolescence: Toward an integrative developmental model. *Annual Review of Clinical Psychology, 10*, 449–476. doi: 10.1146/annurev-clinpsy-032813-153634

de Nijs, P. F., van Lier, P. A., Verhulst, F. C., & Ferdinand, R. F. (2007). Classes of disruptive behavior problems in referred adolescents. *Psychopathology*, *40*(6), 440-445. doi: 10.1159/000107428

Dhingra, K., Boduszek, D., & Sharratt, K. (2015). Victimization Profiles, Non-Suicidal Self-Injury, Suicide Attempt, and Post-Traumatic Stress Disorder Symptomology Application of Latent Class Analysis. *Journal of Interpersonal Violence, 31*(14), 2412-2429. doi: 10.1177/0886260515576967

D'Unger, A. V., Land, K. C., & McCall, P. L. (2002). Sex differences in age patterns of delinquent/criminal careers: Results from Poisson latent class analyses of the Philadelphia cohort study. *Journal of Quantitative Criminology*, *18*(4), 349-375. doi: 10.1023/A:1021117626767

Finch, W. H., & Bronk, K. C. (2011). Conducting confirmatory latent class analysis using Mplus. *Structural Equation Modeling*, *18*(1), 132-151. http://dx.doi.org/10.1080/10705511.2011.532732

Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *American Journal of Orthopsychiatry*, *55*(4), 530-541.

Gibson, W. A. (1959). Three multivariate models: Factor analysis, latent structure analysis, and latent profile analysis. *Psychometrika*, *24*(3), 229-252. doi: 10.1007/BF02289845

Gilbert, R., Kemp, A., Thoburn, J., Sidebotham, P., Radford, L., Glaser, D., & MacMillan, H. L. (2009). Recognising and responding to child maltreatment. *The Lancet*, *373*(9658), 167-180. http://dx.doi.org/10.1016/S0140-6736(08)61707-9

Green, J. G., McLaughlin, K. A., Berglund, P. A., Gruber, M. J., Sampson, N. A., Zaslavsky, A. M., & Kessler, R. C. (2010). Childhood adversities and adult psychiatric disorders in the national comorbidity survey replication I: associations with first onset of DSM-IV disorders. *Archives of General Psychiatry*, *67*(2), 113-123. doi:10.1001/archgenpsychiatry.2009.186.

Hagenaars, J. A., & McCutcheon, A. L. (2002). *Applied latent class analysis*. Cambridge, MA: Cambridge University Press.

Hamby, S., & Grych, J. (2013). *The web of violence: Exploring connections among different forms of interpersonal violence and abuse*. New York, NY: Springer. http://dx.doi.org/10.1007/978-94-007-5596-3

Hazen, A. L., Connelly, C. D., Roesch, S. C., Hough, R. L., & Landsverk, J. A. (2009). Child maltreatment profiles and adjustment problems in high-risk adolescents. *Journal of Interpersonal Violence, 24*(2), 361-378. doi: 10.1177/0886260508316476

Hipp, J. R., & Bauer, D. J. (2006). Local solutions in the estimation of growth mixture models. *Psychological Methods*, *11*(1), 36-53. http://dx.doi.org/10.1037/1082-989X.11.1.36

Jansen, B. R., & van der Maas, H. L. (1997). Statistical test of the rule assessment methodology by latent class analysis. *Developmental Review, 17*(3), 321-357. doi: 10.1006/drev.1997.0437

Johnson, R. J., Ross, M. W., Taylor, W. C., Williams, M. L., Carvajal, R. I., & Peters, R. J. (2006). Prevalence of childhood sexual abuse among incarcerated males in county jail. *Child Abuse & Neglect, 30*(1), 75-86. doi: 10.1016/j.chiabu.2005.08.013

Jones, D. A., Trudinger, P., & Crawford, M. (2004). Intelligence and achievement of children referred following sexual abuse. *Journal of Paediatrics and Child Health, 40*(8), 455-460. Doi: 10.1111/j.1440-1754.2004.00427.x

Jütte, S., Bentley, H., Tallis, D., Mayes, J., Jetha, N., O'Hagan, O., Brookes, H., & McConnell, N. (2015). *How safe are our children? The most comprehensive overview of child protection in the UK*. Retrieved from NSPCC website: http://www.nspcc.org.uk

Kendall-Tackett, K. A., Williams, L. M., & Finkelhor, D. (1993). Impact of sexual abuse on children: a review and synthesis of recent empirical studies. *Psychological Bulletin, 113*(1), 164-180. doi: 10.1037/0033-2909.113.1.164

Lanza, S. T., & Collins, L. M. (2008). A new SAS procedure for latent transition analysis: Transitions in dating and sexual risk behavior. *Developmental Psychology, 44*(2), 446-456. http://dx.doi.org/10.1037/0012-1649.44.2.446

Lanza, S. T., Collins, L. M., Lemmon, D. R., Schafer, J. L. (2007). PROC LCA: A SAS procedure for latent class analysis. *Structural Equation Modeling, 14*(4), 671-694.

Lanza, S. T., Flaherty, B. P., & Collins, L. M. (2003). Latent class and latent transition analysis. In J. A. Schinka, &W. E. Velicer (Eds.), *Handbook of psychology: Research methods in psychology* (pp. 663–685). New York, NY: Wiley.

Laudy, O., Zoccolillo, M., Baillargeon, R. H., Boom, J., Tremblay, R. E., & Hoijtink, H. (2007). Applications of confirmatory latent class analysis in developmental psychology. *European Journal of Developmental Psychology, 2*(1), 1-15. http://dx.doi.org/10.1080/17405620444000193

Lazarfeld, P. F., & Henry, N. W. (1968). *Latent structure analysis*. Boston, MA: Houghton Mifflin.

Leeb, R. T., Paulozzi, L. J., Melanson, C., Simon, T. R., & Arias, I. (2008). *Child maltreatment surveillance: Uniform definitions for public health and recommended data elements, Version 1.0*. Atlanta, GA: Centers for Disease control and Prevention,

National Center for Injury Prevention and Control. Retrieved from http://www.cdc.gov/violenceprevention/pdf/cm_surveillance-a.pdf

Lin, X., Li, L., Chi, P., Wang, Z., Heath, M. A., Du, H., & Fang, X. (2016). Child maltreatment and interpersonal relationship among Chinese children with oppositional defiant disorder. *Child abuse & Neglect*, *51*, 192-202. http://dx.doi.org/10.1016/j.chiabu.2015.10.013

Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika*, *88*(3), 767-778. doi: 10.1093/biomet/88.3.767

Lundberg-Love, P. K., Marmion, S., Ford, K., Geffner, R., & Peacock, L. (1992). The long-term consequences of childhood incestuous victimization upon adult women's psychological symptomatology. *Journal of Child Sexual Abuse*, *1*(1), 81-102. http://dx.doi.org/10.1300/J070v01n01_06

Mathews, B., & Walsh, K. (2004). Queensland teachers' new legal obligation to report child sexual abuse. *Australia and New Zealand Journal of Law and Education*, *9*(1), 25-40.

McCuthcheon, A. L. (1987). *Latent class analysis*. Newbury Park, CA: Sage.

McGee, R. A., & Wolfe, D. A. (1991). Psychological maltreatment: Toward an operational definition. *Development and Psychopathology*, *3*(1), 3-18. https://doi.org/10.1017/S0954579400005034

McLachlan, G. J., & Peel, D. (2000). *Finite mixture models*. New York: John Wiley.

Mills, R., Kisely, S., Alati, R., Strathearn, L., & Najman, J. M. (2016). Child maltreatment and cannabis use in young adulthood: a birth cohort study. *Addiction*. doi: 10.1111/add.13634

Muthén, B. (2003). Statistical and substantive checking in growth mixture modeling: comment on Bauer and Curran (2003). *Psychological Methods, 8*(3), 369-377. http://dx.doi.org/10.1037/1082-989X.8.3.369

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. *Structural Equation Modeling, 9*(4), 599-620. http://dx.doi.org/10.1207/S15328007SEM0904_8

Nooner, K. B., Litrownik, A. J., Thompson, R., Margolis, B., English, D. J., Knight, E. D., ... & Roesch, S. (2010). Youth self-report of physical and sexual abuse: A latent class analysis. *Child Abuse & Neglect*, *34*(3), 146-154. doi: 10.1016/j.chiabu.2008.10.007

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation

study. *Structural Equation Modeling*, *14*(4), 535-569.
doi:10.1080/10705510701575396

Oates, R. K., Forrest, D., & Peacock, A. (1985). Self-esteem of abused children. *Child Abuse & Neglect*, *9*(2), 159-163. doi: 10.1016/0145-2134(85)90007-9

Odgers, C. L., Moretti, M. M., Burnette, M. L., Chauhan, P., Waite, D., & Reppucci, N. D. (2007). A latent variable modeling approach to identifying subtypes of serious and violent female juvenile offenders. *Aggressive Behavior, 33*(4), 339-352. doi: 10.1002/ab.20190

Pears, K. C., Kim, H. K., & Fisher, P. A. (2008). Psychosocial and cognitive functioning of children with specific profiles of maltreatment. *Child Abuse & Neglect*, *32*(10), 958-971. doi: 10.1016/j.chiabu.2007.12.009

Perestelo-Pérez, L. (2013). Standards on how to develop and report systematic reviews in Psychology and Health. *International Journal of Clinical and Health Psychology*, *13*(1), 49-57. doi: 10.1016/S1697-2600(13)70007-3

Petrenko, C. L., Friend, A., Garrido, E. F., Taussig, H. N., & Culhane, S. E. (2012). Does subtype matter? Assessing the effects of maltreatment on functioning in preadolescent youth in out-of-home care. *Child Abuse & Neglect, 36*(9), 633-644. http://dx.doi.org/10.1016/j.chiabu.2012.07.001

Polusny, M. A., & Follette, V. M. (1995). Long-term correlates of child sexual abuse: Theory and review of the empirical literature. *Applied and Preventive Psychology*, *4*(3), 143-166. doi: 10.1016/S0962-1849(05)80055-1

Ramaswamy, V., DeSarbo, W. S., Reibstein, D. J., & Robinson, W. T. (1993). An empirical pooling approach for estimating marketing mix elasticities with PIMS data. *Marketing Science*, *12*(1), 103-124. http://dx.doi.org/10.1287/mksc.12.1.103

Reidy, D. E., Smith-Darden, J. P., & Kernsmith, P. D. (2016). Behavioral and mental health correlates of youth stalking victimization: a latent class approach. *American Journal of Preventive Medicine*. http://dx.doi.org/10.1016/j.amepre.2016.08.035

Roesch, S. C., Villodas, M., & Villodas, F. (2010). Latent class/profile analysis in maltreatment research: A commentary on Nooner et al., Pears et al., and looking beyond. *Child abuse & Neglect*, *34*(3), 155-160. doi: 10.1016/j.chiabu.2010.01.003

Rumble, L., Ramly, A. A., Nuryana, N., & Dunne, M. P. (2017). The importance of contextual factors in carrying out childhood violence surveys: A case study from Indonesia. *Child Indicators Research*. doi: 10.1007/s12187-017-9457-8

Sanders, M. R., Cann, W., & Markie-Dadds, C. (2003). Why a universal population-level approach to the prevention of child abuse is essential. *Child Abuse Review*, *12*(3), 145-154. doi: 10.1002/car.797

Schwarz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics*, *6*(2), 461-464. http://projecteuclid.org/euclid.aos/1176344136

Sclove, S. L. (1987). Application of model-selection criteria to some problems in multivariate analysis. *Psychometrika*, *52*(3), 333-343. doi: 10.1007/BF02294360

Scott, J., Varghese, D., & McGrath, J. (2010). As the twig is bent, the tree inclines: adult mental health consequences of childhood adversity. *Archives of General Psychiatry*, *67*(2), 111-112. doi:10.1001/archgenpsychiatry.2009.188

Shaw, M., & De Jong, M. (2012). Child abuse and neglect: a major public health issue and the role of child and adolescent mental health services. *The Psychiatrist Online*, *36*(9), 321-325. doi:10.1192/pb.bp.111.037135

Shevlin, M., & Elklit, A. (2008). A latent class analysis of adolescent adverse life events based on a Danish national youth probability sample. *Nordic Journal of Psychiatry*, *62*(3), 218-224. http://dx.doi.org/10.1080/08039480801983992

Shevlin, M., Murphy, S., & Murphy, J. (2014). Adolescent loneliness and psychiatric morbidity in the general population: Identifying "at risk" groups using latent class analysis. *Nordic Journal of Psychiatry*, *68*(8), 633-639. http://dx.doi.org/10.3109/08039488.2014.907342

Stoltenborgh, M., Bakermans-Kranenburg, M. J., Alink, L. R., & IJzendoorn, M. H. (2015). The Prevalence of Child Maltreatment across the Globe: Review of a Series of Meta-Analyses. *Child Abuse Review, 24*(1), 37-50. doi: 10.1002/car.2353

Thomas, H., & Hettmansperger, T. P. (2001). Modelling change in cognitive understanding with finite mixtures. *Journal of the Royal Statistical Society: Series C (Applied Statistics), 50*(4), 435-448. doi: 10.1111/1467-9876.00246

Tong, L., Oates, K., & McDowell, M. (1987). Personality development following sexual abuse. *Child Abuse & Neglect*, *11*(3), 371-383. doi: 10.1016/0145-2134(87)90011-1

Vachon, D. D., Krueger, R. F., Rogosch, F. A., & Cicchetti, D. (2015). Assessment of the harmful psychiatric and behavioral effects of different forms of child maltreatment. *JAMA Psychiatry*, *72*(11), 1135-1142. doi: 10.1001/jamapsychiatry.2015.1792

Vaughn, M. G., Salas-Wright, C. P., Underwood, S., & Gochez-Kerr, T. (2015). Subtypes of non-suicidal self-injury based on childhood adversity. *Psychiatric Quarterly*, *86*(1), 137-151. doi: 10.1007/s11126-014-9313-7

Villodas, M. T., Litrownik, A. J., Thompson, R., Roesch, S. C., English, D. J., Dubowitz, H., ... & Runyan, D. K. (2012). Changes in youth's experiences of child maltreatment across developmental periods in the LONGSCAN consortium. *Psychology of Violence*, *2*(4), 325. http://dx.doi.org/10.1037/a0029829

Williams, K., Papadopoulou, V., & Booth, N. (2012). *Prisoners' Childhood and Family Backgrounds: Results from the Surveying Prisoner Crime Reduction (SPCR) Longitudinal Cohort Study of Prisoners*. Ministry of Justice. Retrieved from http://www.justice.gov.uk/publications/research-and-analysis/moj

Witt, A., Münzer, A., Ganser, H. G., Fegert, J. M., Goldbeck, L., & Plener, P. L. (2016). Experience by children and adolescents of more than one type of maltreatment: association of different classes of maltreatment profiles with clinical outcome variables. *Child Abuse & Neglect*, *57*, 1-11. http://dx.doi.org/10.1016/j.chiabu.2016.05.001

Wolfe, D. A., & McGee, R. A. (1994). Dimensions of child maltreatment and their relationship to adolescent adjustment. *Developmental Psychopathology*, *6*, 165–181. http://dx.doi.org/10.1017/S0954579400005939

World Health Organization (WHO). (2016). *Child maltreatment*. Retrieved from http://www.who.int/