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RESEARCH ARTICLE

Quantitative Evaluation of a Pan-European Multi-professional Digital Training Programme for Stopping Child Maltreatment (ERICA)

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Abstract

Child maltreatment is a global public health problem affecting individuals, families, and societies. Although there are a number of programmes aimed at preventing child maltreatment, there is limited information available on their effectiveness or impact. This study aims to quantitively evaluate a recently developed pan-European digital training programme for the identification and prevention of child maltreatment within families—ERICA. Professionals working with children and families who have limited experience in child protection (e.g. healthcare workers, teachers) were recruited for the ERICA training in the seven collaborator countries (England, Finland, France, Germany, Italy, Poland, and Scotland). Participants were 303 professionals who completed online self-evaluation questionnaires. In each collaborator country, trainee skills and knowledge were self-assessed twice via an anonymous online questionnaire, pre- and post-ERICA training. Principal component analysis (PCA) was used to summarise questionnaire items into latent components in self-assessed skills and knowledge across all participants ($n = 303$), and then we compared pre- and post-training factor scores for participants with both pre- and post-responses ($n = 185$) using mixed-effect regression. For all 52 questionnaire items, we found statistically significant improvements ($p < 0.001$) between self-evaluated skills and knowledge comparing pre- and post-training. Exploratory analysis using PCA derived eight summary scales based on latent components, which addressed overall expertise, competence, skills, communication with children, engagement with the family, early signs, support, and intervention. The factor scores for the eight summary scales also showed consistent pre–post-training improvements. The findings suggest a likely improvement in trainees' self-assessed skills and knowledge of child maltreatment after taking the ERICA digital training. Improvement was found across all seven countries, suggesting the training's transferability across different settings and their unique cultural, legislative, and healthcare contexts.

Keywords Prevention programme evaluation · Child maltreatment prevention · Non-specialist professionals · Interdisciplinary · Digital · Principal component analysis

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Introduction

The Convention on the Rights of the Child states that all children have the right to be free from all forms of violence (UNICEF, 1989). However, globally, nearly three quarters of children aged 2 to 4 years suffer physical and psychological maltreatment from family and carers, and one in five women and one in 13 men report sexual abuse during childhood (World Health Organisation, 2025). The World Health Organisation (WHO) defines child maltreatment (CM) as "the abuse and neglect that occurs to children under 18 years of age. It includes all types of physical and/or emotional ill-treatment, sexual abuse, neglect, negligence and commercial or other exploitation, which results in actual or potential harm to the child's health, survival, development or dignity in the context of a relationship of responsibility, trust or power" (World Health Organisation, 2025). In 2015, the prevalence of CM in the European region stood at 9.6% for sexual abuse, 22.9% for physical abuse and 29.1% for emotional abuse (World Health Organisation, 2015).

The importance of addressing CM is highlighted by research, showing that it results not only in immediate physical and mental harm to children, but also in long-term consequences throughout their lives at individual, relationship, community, and/or social levels (Bellis et al., 2013; Nelson et al., 2020; UN World Health Organisation, 2016). Evidence shows that individuals who experience childhood adversity and, specifically, childhood trauma are affected on neurological and biological levels in social information processing (enhanced threat detection, hostile attribution bias), emotion processing (heightened emotion reactivity, poor emotion regulation), and accelerated biological ageing (pubertal timing, cellular ageing) (McLaughlin et al., 2019, 2020). MRI studies with adolescents who experienced childhood trauma found differences in their automatic emotional regulation, i.e. increased emotional reactivity, low emotional awareness, and magnified/prolonged emotional response (Kim et al., 2021; Marusak et al., 2015). Maltreatment in childhood has been associated with complex post-traumatic stress disorder (PTSD) (Khoury et al., 2010; Teicher et al., 2006), particularly in adult survivors of childhood sexual abuse (Gold, 2000). Additionally, CM has been associated with adverse childhood experiences (ACEs) (Dube et al., 2003; Hughes et al., 2017; Public Health Wales, 2020), substance misuse (Mills et al., 2006), and attachment styles affecting treatment seeking (Caspers et al., 2006; Schindler, 2019), intergenerational CM (Madigan et al., 2019), and most recently with complex generational and interpersonal trauma (Garami et al., 2019; Meulewaeter et al., 2019; van der Kolk, 2015).

Therefore, international and national authorities view CM as a public health issue and actively promote CM prevention strategies aimed at improving local practices across multiple countries. For instance, the WHO established a policy framework, Health 2020 (World Health Organisation, 2013), specifically for the European region, which supports governments and societies in establishing a common framework to help member states learn from each other and exchange good practice knowledge. The framework gathers evidence regarding effective

practice in identifying and preventing CM and supporting children and families (World Health Organisation, 2013). Complementing this, the WHO INSPIRE programme (UN World Health Organisation, 2016) has become an evidence-based document that outlines seven strategies for ending violence against children. The programme (UN World Health Organisation, 2016) also identifies a select group of strategies that have shown success in reducing violence against children, such as an increase in (a) parent and caregiver support, (b) response and support services, and (c) education and life skills.

Despite these efforts, CM prevention seems to have limited success (Bhatnagar, 2022). Some of the challenges in addressing CM are due to the complex combination of the skills and knowledge required from the professionals working with children and families, such as relational building, positive communication, the ability to provide emotional support (Schreiber et al., 2013), holding uncertainty, adapting interventions to the specific situations, critically drawing on emotions and subjective relational knowledge (Staempfli, 2020), and self-evaluation and reflection as part of continuous professional growth (Estyn, 2023). The available CM prevention programmes have limited information about their effectiveness or impact, especially considering professionals' engagement (MacMillan et al., 2009) and often have severe methodological problems, making the impact of the training programmes difficult to interpret (Gautschi & Lätsch, 2024). However, those training programmes that do evaluate their effectiveness report a positive impact on professionals' attitudes and knowledge on approaching and managing CM (Christensen et al., 2024; Dubowitz et al., 2011; Gün et al., 2022; Kita et al., 2023; Louwers et al., 2012; Mandadi et al., 2021; Paek et al., 2019; Smeekens et al., 2011). For instance, a brief 2-h child abuse training delivered to physicians, nurses, emergency medical technicians, and other hospital staff was found to improve hospital staff's knowledge, confidence, and willingness to report child abuse (Paek et al., 2019). An example of webinars and workshops aimed at enhancing frontline workers' skills in dealing with children and young people involved in harmful sexual behaviour showed increased awareness of the topic, improved staff's confidence and handling of sensitive cases, and resulted in a better understanding of how to work with children and families affected by harmful sexual behaviours (Christensen et al., 2024). Professionals working with children are known to identify the high level of training needs in relation to CM (Leppäkoski et al., 2019). This, accompanied by research showing social support to be a protective factor against CM (McLaughlin et al., 2019, 2020), and the effectiveness of early interventions within social systems around children (Berk et al., 2020; Gillespie et al., 2019), such as schools (Flynn et al., 2018; Gasol et al., 2022), highlight the need for training programmes aimed at a range of professionals working with children/adolescents on a daily basis.

This paper reports on the quantitative evaluation of the ERICA project (brief acronym for the full title of the project "Stopping Child Maltreatment through Pan-European Multiprofessional Training Programme: Early Child Protection Work with Families at Risk"), a training programme specifically conceived for professionals working with children and families who do not specialise in child protection or CM and have limited experience in this area (hereafter known as "non-specialist professionals") across Europe for the identification and prevention of CM within families

by assessing changes in intended learning outcomes among the participants. The supplementary aim of the current paper was also to assess whether ERICA training programme effects and impact varied due to participant background. The latter aim was key for addressing the pan-European nature of the project, including cultural and societal differences between the countries, as well as a wide range of differences in trainee professional and experiential background.

Methods

ERICA Training Programme

The ERICA project consisted of developing, piloting, evaluating, and revising a 2-day multidisciplinary modular facilitated course conducted virtually. Methods combined theory, peer learning, reflective conversations, and introduction to practical tools in relation to recognition, assessment of CM, family support, and referral to further support services. As such, the ERICA project responds to the European call to prevent CM (World Health Organisation, 2013) and the INSPIRE framework (UN World Health Organisation, 2016), through strengthening the institutional system's response to the prevention of CM.

As full details of the development and structure of the training are published elsewhere (Zlatkute et al., 2021, October 15), we provide only brief details. The ERICA training was developed following a comprehensive needs evaluation consisting of a systematic literature review, an audit of local good practices in our seven country settings, and an anonymous training needs survey administered among our target group of professionals (Appleton et al., 2022). The training consisted of seven modules plus an evaluation, which are all, alongside instructions on how to run the training, freely available to any interested trainers (please see https://www.entermentalhealth.net/ericatraining). Modules covered topics such as risk and protective factors, consequences of maltreatment, recognising early signs, risk assessment tools, and intervention techniques. Training materials were a mix of presentation slides, animated videos, case studies, and handouts on key skills. All countries used the same version of training materials (EU Ver. 1.0, available at https://www.entermentalhealth.net/ericatraining), which were then translated (or subtitled) into local languages alongside any necessary translational adaptations. The training was delivered by a pair of experienced health, child psychology, or social care professionals, with at least one being experienced in working with or training professionals in dealing with CM cases. Trainers had detailed briefings before delivering the training and decided on how they would co-deliver the training. The trainers provided feedback and evaluation of the training materials throughout their involvement in the project.

For each cohort, training was delivered over 16 h, approximately half of which consisted of online virtual training with facilitators (divided into two separate sessions), and the remainder of the time was devoted to self-learning and feedback. Self-learning consisted of participants being provided with the materials in advance, preparatory tasks, and watching supplementary videos/online materials.

Participant Recruitment and Consent

We conducted pilot training with two cohorts in each of the seven partner countries (England, Finland, France, Germany, Italy, Poland, and Scotland). Participant recruitment was carried out separately within each country (collaborator site). Each collaborator site informed their institutions about the data gathering during ERICA training piloting, obtained necessary ethical approvals, and carried out recruitment in accordance with their institutions' ethical considerations (more details in Zlatkute et al., 2021, October 15). Within each collaborating site, project leads used their professional, institutional, national, and personal networks to advertise the ERICA training programme using online methods, which included invitations to ERICA training via organisational and professional emails, institutional and organisational newsletters, and professional Facebook groups.

All individuals who expressed interest in attending the ERICA training were provided with further information about the training programme and asked to complete the online questionnaire prior to attending. The online questionnaire had a landing page providing information about the ERICA project, including its aims, ethical considerations, and information linked to data gathering via the questionnaire. Landing page information was adapted by each collaborating site and translated in accordance with the relevant ethical regulations (see Supplementary Material 1 for the English version used in Scotland). By ticking the box at the bottom of the landing page, trainees who chose to fill in the questionnaire provided informed consent for their responses to be used to improve the ERICA training programme and to be used further for scientific purposes in an anonymised form.

Measures and Evaluation Procedure

The ERICA training developers had multiple considerations for identifying and developing the evaluation of the ERICA training and the impact it had on the trainees.

Research suggests that self-assessment in one's knowledge among students can be inaccurate, with students who lack knowledge in a certain area often overestimating their knowledge (Colthart et al., 2008; Leon et al., 2021; Tang et al., 2023). However, when it comes to professionals working with children and young people in complex and dynamic environments, self-assessment of knowledge and skills as part of reflective self-evaluations is a common and important practice (Amin et al., 2025; Department for Education, 2018; Staempfli, 2020). Research, government guidelines, and public policies suggest multiple benefits of self-assessment and self-evaluation among staff working with children and young people. Some of these benefits are improved service quality and child outcomes (Estyn, 2023), enhanced professional development (Social Work England, 2020), strengthened accountability and transparency (Department for Education, 2023), and facilitated collaboration and shared learning (West Partnership, 2021). Self-evaluation, assessment of one's skills, actions, and knowledge, and then, reflection open them, is highlighted as an

intrinsic part of professional working around complex issues such as CM and assessment of risk (Department for Work & Pensions, 2014; Education & Training Inspectorate, 2024; Staempfli, 2020). Additionally, ERICA training aimed to recruit a wide range of non-specialist professionals working with children and families, and thus, we anticipated that their baseline (pre-training) knowledge, skills, and experiences would vary (e.g. nurse vs voluntary agency worker). Thus, an approach suitable for a wide range of professionals, working in different countries with varying legal and healthcare systems, was required.

Due to the considerations outlined, the ERICA training developers chose to use self-assessment as part of reflective self-evaluation for a varied range of professionals working with children. Furthermore, we focused our analysis on the difference between the pre- and post-ERICA training self-evaluation scores. Thus, if the suggested bias of overestimating one's knowledge would be present in our sample, then the scores for pre-training would be high and/or not statistically significant from the post-training scores.

The self-assessment questionnaire used to evaluate the ERICA training was based on the questionnaire used to evaluate the impact of a European training programme for supporting children who have parents with mental illnesses and/or with substance misuse (Viganò et al., 2017). The questionnaire was adapted based on previous content and methodological literature (Diener et al., 2010; Kirkpatrick & Kirkpatrick, 2006) and versions of the educational evaluation form used in the project group's previous EU projects (Viganò et al., 2017). The final version of the questionnaire was specific to the current ERICA project based on identification, detection, and risk assessment; developmental consequences; intervention planning; and engagement, communication, and direct support. It aimed to explore the self-reported impact of the training; thus, it was not validated. However, participants were encouraged to ask clarifying questions at the beginning of the training about any pre-training provided information, which included the pre-training questionnaire, and the post-training questionnaire included additional open-ended questions to facilitate further feedback.

In each cohort, participants self-assessed their knowledge and skills via the questionnaire at two time points: before the training and at the training's completion. The questionnaire was anonymous, and participants were encouraged to not share details that could identify any child or young people or their families. On registration to the ERICA training, participants were sent an online questionnaire to complete (available in every partner's language); responses received any time from registration to the first day of the training were considered. On completion of the training, participants were provided the post-online questionnaire (also translated into local languages), which was consistent with the previous one. The post-training questionnaire included two additional open-ended questions to gather feedback about training delivery and other suggested improvements. The majority of post-training responses were completed on the last day of training, but in some exceptional cases, we considered responses completed up to 1 week after.

The four-level Kirkpatrick model framework was used to design the questionnaire participants completed and to evaluate specific learning outcomes (Kirkpatrick, 1959). A consensus on the different questionnaire items and wording was reached

during a transnational meeting with collaborators from all seven countries (a copy is available in SupplementaryMaterial 1). The current study focuses on the second level of the Kirkpatrick model, which measures trainees' learning through a comparison between pre- and post-training scores.

The evaluation components can be divided into two macro-dimensions: self-assessed *knowledge* of professionals on several issues related to CM, and self-assessed *skills* that professionals should have when dealing with children. Under the *knowledge* dimension, nine separate elements were self-assessed, including child development, consequences of maltreatment, risk and protective factors, cultural differences, and pandemic responses, including early signs of maltreatment and neglect within the family, responses and engagement with children and families, and risk assessment skills. Under the self-assessed *skills* dimension, there were 17 indicators covering: risk assessment, spotting signs of maltreatment, engaging with children and their families, designing interventions, interprofessional working, pandemic working, and different forms of intervention. The questionnaire was meant to capture the trainees' self-assessed knowledge and skills as part of reflective self-evaluation. Therefore, participants self-assessed the awareness and competence of each of the 26 items on a 5-point Likert-type scale, resulting in a total of 52 different evaluation items. A complete list of the items is contained in Supplementary Material 2.

Additionally, along with the information on basic sociodemographic data and current working role, previous experiences of learning empowerment programmes were also collected.

Participant Sample

The size of cohorts recruited in each partner site (countries) varied, with the minimum being nine individuals (England), the maximum being 38 (Scotland), and the mean and median across all countries and cohorts being 23 individuals.

Pooling evaluation questionnaires across all seven countries, there were 600 pre- and post-training responses combined from 328 different individuals. Participants who could not join the first training session but attended the second part of the training were excluded from the analysis. Of the 303 participants who completed the pre-training questionnaire, 185 (61%) also completed the post-training questionnaire; these participants were our main analysis sample. The proportion of complete surveys was 83.1%, and 15.5% were nearly complete (between one and five answers were missing or could not be evaluated). The remaining 1.4% of questionnaires had larger numbers of missing responses, mostly because respondents had missed whole pages of the questionnaire.

We collected and summarised information on professionals' characteristics, including age, gender, educational profile (considering bachelor's, master's or doctoral degrees), work sector (e.g. nursing, midwifery, psychiatrists/psychologists, school teachers), and level of experience (working years in the specific sector) categorised into entry-level (<1 year), intermediate (1–5 years), and senior (>5 years). They had experience with different recipients (children and adolescents as well as families and adults) across different settings, including advice/support/counselling

centres, communities, hospitals, medical, health or mental health centres, as well as kindergarten/nursery, schools, and social welfare/social care centres. A detailed description of respondent characteristics is reported in the participant sample description paragraph in the "Results" section. In addition, since 118 out of 303 participants who completed the pre-training questionnaire dropped out of the training, we compared the characteristics of participants who completed only the pre-training questionnaire ($n = 118$) with those who completed both pre- and post-training questionnaire ($n = 185$, and used in the main analysis). Full details are provided in the "Participant Sample" paragraph in the "Results" section.

Analytical Approach

The effectiveness of the ERICA training was assessed through a statistical comparison of pre- and post-training scores. First, considering the 52-item self-assessment questionnaire, two-tailed paired *t*-tests were carried out to assess pre–post-differences based on a single-item analysis. This approach allowed us to examine item-level changes in participants' responses, providing a granular understanding of the potential effects. Moreover, given the exploratory nature of the study, we decided to use principal components analysis (PCA) to reduce the evaluation components derived from the questionnaire to a smaller set of variables that we could examine in the pre- and post-training questionnaires. PCA is a widely used technique for data reduction for both continuous and ordinal scale data (Abdi & Williams, 2010) and has been extensively applied to Likert scale data in a variety of fields, such as psychology and education research (e.g. DuPaul et al., 1991). Indeed, it contributed to minimising noise and redundancy while identifying underlying patterns and uncovering potential latent constructs. Although the questionnaire was originally designed to assess multiple distinct dimensions of self-assessed knowledge and skills, PCA allowed us to account for potential interrelationships among items, highlighting how they may naturally cluster, thus allowing for a more holistic understanding of the data. With a need for reducing complexity, this approach likely enhanced the theoretical coherence of the constructs, which in turn may have supported the internal consistency of our findings, ultimately facilitating a more interpretable presentation of results.

There were two steps in this exploratory analysis. First, to establish the number of principal components, we comprehensively used the pre-training data available from all participants ($n = 303$). In doing so, each of the 52 components were retained as a 5-point scale. After running the PCA, we reviewed the eigenvectors and eigenvalues and used them to draw a scree plot. The number of components was chosen based on considering the ranked eigenvalues and the cumulative proportion of total variability explained. For the chosen components, we explored the items which loaded most strongly onto each one and, based on this, assigned qualitative labels. We considered unrotated elements, considering those with positive scores as loading onto each component. For each component, we generated a proxy measure factor by combining previously selected items using the mean

score. This, for all participants with complete data on items loading on the specific component, was a continuous score for each component at each time point.

The second step was to compare pre- and post-training factor scores for a subset of those with complete pre–post-data ($n = 185$). In basing our analysis on complete case data, we adopted the missing at random assumption. We compared descriptive statistics (mean, SD) of the pre- and post-training factor scores (performing bivariate analyses based on paired Student's t or non-parametric tests, according to data distribution), and how they were distributed across different socio-demographic and professional characteristics and between countries. Finally, using a mixed-effect regression model including all pre- and post-data, we regressed scores for each component with time as a dummy variable (pre- or post-training) to formally investigate whether there was a statistically significant difference in scores for each before and after the training. Some covariates (e.g. level of experience and workplace) were also entered into mixed-effects regression.

Results

Participant Sample

As a whole, 303 professionals participated in the ERICA programme. However, 118 (39%) participants completed just the pre-training questionnaire. Although trainees with only pre-training data were more likely to come from certain countries (e.g. England, Germany) (chi-square $p = 0.021$), the distribution of individual characteristics did not differ statistically between groups of participants with only pre-training vs complete data, including age ($p = 0.970$), gender ($p = 0.715$), work sector (0.489), educational profiles ($p = 0.653$), and level of experience ($p = 0.733$); further details are provided in supplementary materials (SupplementaryMaterials 3). This suggested the minimal risk of sample bias from missing data and justified our adoption of the missing-at-random assumption.

The complete (analysis) sample ($n = 185$, 61%) included participants from all countries, but with a high proportion from Finland (16.2%), Poland (27.9%), and Scotland (21.6%). The mean age was around 39 years (SD = 11 years), and it was more than 90% female. The majority of the sample was highly educated (88%), having either a bachelor's, master's, or doctoral degree. Participants came from a range of professional backgrounds, with around one-third coming from a medical background (predominantly nursing, midwifery); the next largest group was psychiatrists/psychologists, followed by participants from an educational background, predominantly primary or secondary school teachers. Additionally, some participants were voluntary agency workers, volunteer sports trainers, or social workers and were working in community, advice/support/counselling centres, social welfare centres/social care centres, or other organisations. Work experience ranged from less than a year (15% of the sample) to 39 years, with an average of 9.7 years (SD = 9.3).

Item Analysis

Pre- versus post-training scores were compared for all the 52 items evaluating self-assessed skills awareness, skills competence, knowledge awareness, or knowledge competence, respectively (Supplementary Material 2). Based on dependent sample *t*-tests, two-tailed, statistically significant changes ($p < 0.001$) were observed across all single items over time with the vast majority showing mean differences between 0.75 and 1.25 points. Most of the largest average improvements were estimated for items with relatively low pre-training means, such as awareness and competence with respect to the skill "Spotting and assessing possible maltreatment in the era of physical distancing", or awareness and competence with respect to the knowledge of "Various protective factors for different kinds of child maltreatment" and "Differences/heterogeneities in risk factors across contexts, including cultural differences in parenting practices".

Results of PCA

Collected pre-training data from the complete sample ($n = 303$) allowed us to select eight latent components according to PCA-based estimates. All retained factors had eigenvalues equal to or greater than 1, accounting for 79% of the cumulative variance. Thus, eight summary scales were developed. Relevant labels were assigned based on the items which loaded onto the corresponding principal components (SupplementaryMaterial 4). These included (1), overall expertise, (2) competence, (3) skills, (4) communication with children, (5) engagement with the family, (6) early signs, (7) support, and (8) intervention. All items from the questionnaire encompassed the "Overall expertise" latent component, accompanied by two constructs reflecting the different competence- and skill-related items, separately. Moreover, considering the highest loadings, "Communication with children" was defined especially considering items "Child development"; "Talking with and supporting children"; "Communication with children where safeguarding concerns are identified", while "Adapting, maintaining and evolving engagement with children and families through new means ie: technology development"; "Various protective factors for different kinds of child maltreatment"; and "Availability of protective factors for intervention", mainly defined "Engagement with the family".

In addition, items "Adapting, maintaining and evolving engagement with children and families through new means ie: technology development", "Spotting typical/classic observable signs that children may be suffering maltreatment of various kinds", and "Distinguishing between what might be considered 'normal' phases of development and sensing that there may be a problem", all loaded moderately and moderately high onto the "Early signs" latent construct, suggesting professionals' perspective about the acknowledgment and possibly need for digital health tools for CM early detection.

Components related to "Support" and "Intervention" were mainly related to "Talking with an abusive parent to motivate this parent to stop the maltreatment", "Providing support at key vulnerability points in children's lives, such as moving

house, family disruption, changes in siblings, etc.", and "Designing intervention protocols/documents", "Talking with and supporting children", and "Talking with an abusive parent to motivate this parent to stop the maltreatment", respectively. A few items displayed moderate cross-loadings; these were retained for exploratory purposes but are noted as potentially ambiguous in their factor alignment. Full details about the item loadings of non-mutually exclusive latent constructs are displayed in Supplementary Material 4.

Considering the subsample of participants with pre- and post-data, descriptions and summary statistics of pre- and post-training scores by time point are provided in Table 1 (means, SDs) and in Fig. 1 (medians, IQRs). In addition, pre- and post-scores of the individual items are documented in Supplemental Material 5, thus showing individual changes in the 52 items over time.

In addition, we explored whether pre-training scores varied by participant key characteristics. Workplace, the type of profession, and level of experience were found to be associated with pre-training levels of the different components (estimated mean scores are presented in SupplementaryMaterial 5). Therefore, subsequent analyses were controlled for these variables.

Training Evaluation

On average, participants reported higher self-assessed scores at post-training compared to pre-training across all scales (Fig. 2). A bivariate analysis was carried out, highlighting statistically significant pre–post-changes considering all factors' scores over time (Table 1). The highest mean scores were observed for the communication component and the lowest for competence.

We also observed higher mean self-assessed scores in a post- vs pre-, for every scale, in every country (SupplementaryMaterial 6). Generally, German participants showed the largest improvements, and Finnish participants the lowest, although there was variability in sample sizes between the countries (England $n=8$; Finland $n=30$; France $n=28$; Germany $n=18$; Italy $n=15$; Poland $n=46$; Scotland $n=40$).

To investigate whether there was a statistically significant improvement in mean values of the eight scales, we used a series of mixed-effects regressions considering all participants of our sample, specifying random effects for country and participants. Table 2 shows that across all outcomes, there was a significant time effect; that is, post-training mean self-assessed scores were significantly higher than pre-training self-assessed scores for all scales. This result persisted when controlling for potential confounders such as level of experience and workplace (Table 2), even though more experienced participants, as well as kindergarten/nursery professionals, were more likely to report higher scores at various scales as compared to their counterparts.

We also noted a "ceiling effect", such that those participants who scored highly at pre-training evaluation saw lesser improvements in scores on the 5-point Likert-type scale. This is illustrated in Fig. 3 by a negative correlation between the difference in pre- and post-training scores (delta overall expertise) and the pre-training

Table 1 Summary statistics for the 8 summary scales derived from PCA ($n=185$)

Scale	**Pre-training** scores mean (SD)	**Post-training** scores mean (SD)	**Pre–post-difference mean (SD)**	**Statistical significance *p*-value (t*)**
1. Overall expertise	3.08 (0.82)	4.06 (0.69)	0.97 (0.70)	< 0.001 (15.89)
2. Competence	2.82 (0.87)	3.88 (0.80)	1.02 (0.81)	< 0.001 (15.4)
3. Skills	3.06 (0.83)	4.02 (0.70)	0.95 (0.71)	< 0.001 (16.7)
4. Communication with children	3.33 (0.82)	4.17 (0.69)	0.84 (0.69)	< 0.001 (14.8)
5. Engagement with the family	3.06 (0.81)	4.00 (0.73)	0.95 (0.70)	< 0.001 (17.4)
6. Early signs	3.09 (0.80)	4.09 (0.72)	0.99 (0.69)	< 0.001 (18.1)
7. Support	3.12 (0.79)	4.05 (0.71)	0.92 (0.67)	< 0.001 (17.5)
8. Intervention	3.06 (0.83)	4.04 (0.69)	0.96 (0.69)	< 0.001 (16.9)

*Paired *t*-test

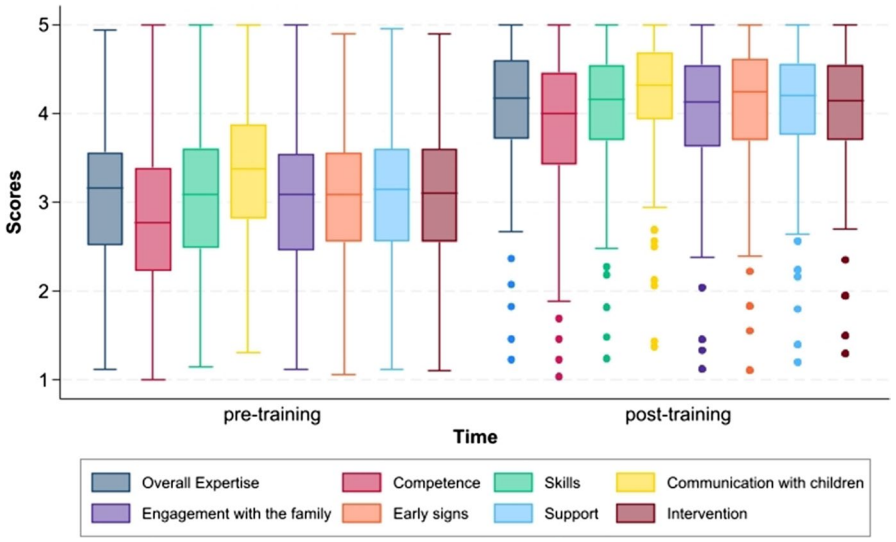

Fig. 1 Boxplot of the 8 summary scales, comparing pre- and post-training distributions

score (overall expertise pre-training). However, a few participants scoring low on the pre-training self-assessment did not show any improvement in post-training self-assessed scores (Fig. 1).

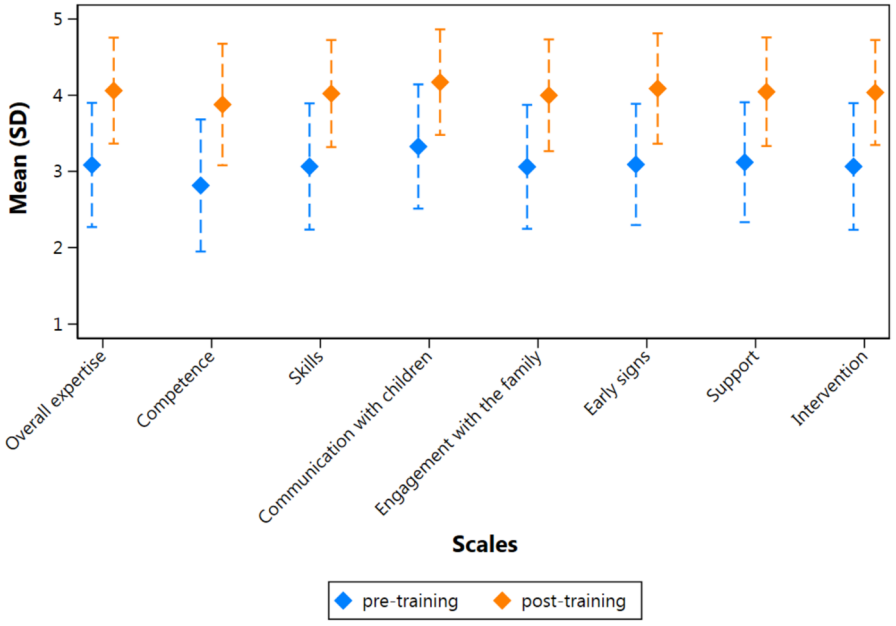

Fig. 2 Means of the eight scales by time (pre- vs. post-training), seven countries combined ($n = 185$)

Table 2 Regression coefficients for time (post-training compared to the reference category of pre-training) in mixed-effects regressions of pre–post-data ($n = 185$)

Outcome: mean scores across 8 scales, post-training vs pre-training*	Coefficient	95%CI	*p*-value
Overall expertise	0.94	0.83; 1.05	< 0.001
Competence	1.01	0.89; 1.13	< 0.001
Skills	0.93	0.82; 1.03	< 0.001
Communication with children	0.81	0.71; 0.91	< 0.001
Engagement with the family	0.93	0.82; 1.03	< 0.001
Early signs	0.96	0.86; 1.06	< 0.001
Support	0.89	0.80; 0.99	< 0.001
Intervention	0.94	0.84; 1.05	< 0.001

*Subject and country as random effects; controlling for level of experience and workplace

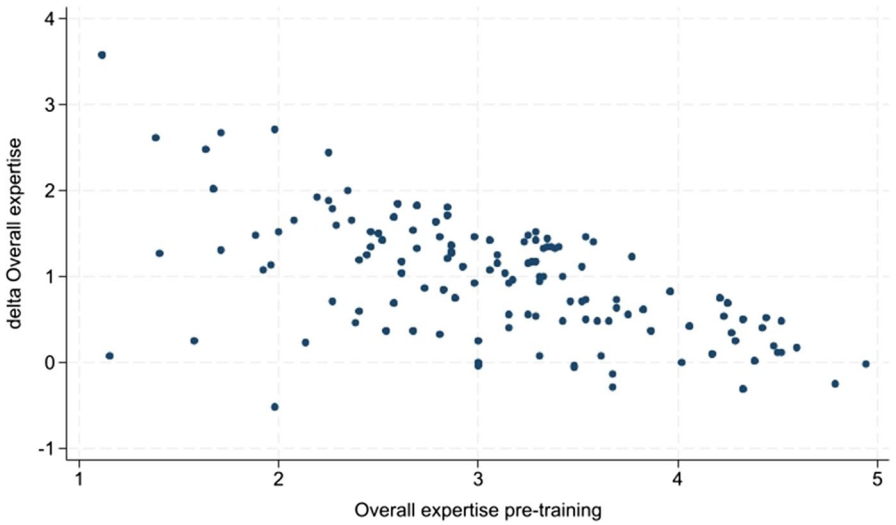

Fig. 3 Correlation between overall pre-training expertise and difference (i.e. delta) in pre- and post-training scores

Discussion

The research presented in this paper aimed to quantitatively evaluate the effect of the ERICA multi-professional and pan-European training programme, which aims to build professionals' self-evaluated awareness of and capacity to assess the risk of CM. This was achieved by a pre- and post-comparison of trainees' self-assessed skills and knowledge, using single-item variations and data-derived components. Participants who scored lower at pre-training evaluation showed higher improvements, especially for items "Spotting and assessing possible maltreatment in the era of physical distancing", "Various protective factors for different kinds of child maltreatment", and "Differences/heterogeneities in risk factors across contexts, including cultural differences in parenting practices". A further exploratory PCA analysis revealed potential latent components each capturing distinct dimensions of professional practice relevant to CM. Some of the data-derived components, like early signs, had a direct link to CM and its risk identification. Other components were more related to general skills and knowledge (e.g. skills, communication with children, and engagement with the family), which supports the notion that a complex set of skills and knowledge is necessary for professionals' practice, especially when drawing objective and subjective evidence together during CM risk assessment (Austin et al., 2021; Department for Education, 2023; Social Work England, 2020; Staempfli, 2020).

Overall, the results show that post-training scores on all latent components were higher than pre-training scores, suggesting a significant improvement in trainees' self-assessed skills and knowledge of CM after taking part in the ERICA training course. This improvement was consistent for all trainees with varying cultural and social backgrounds, as well as professions and experience of working with children. The highest self-assessed change was found for *Communication with children*. This is an important improvement, as communication skills and confidence in using them are crucial in the process of building and maintaining relationships of trust with abused children (Anderson et al., 2014; Lamb & Brown, 2006; Staempfli, 2020). This relationship is the basis for many of the other factors, such as the detection of risk factors, early signs of maltreatment, and providing support (Lamb & Brown, 2006). Just as for all other improvements, the significant change in communication with children was supported after controlling for trainees' characteristics. This suggests that the ERICA training benefitted professionals of varying social GGRRAA ACCEEESSS (an acronym, where every letter stands for a different descriptive aspect of professional and social identity, e.g. gender, education, and age (Birdsey & Kustner, 2020; Burnham, 2012)) and may be adapted to a range of work settings and environments.

Although the improvement was observed for trainees with varying backgrounds even taking into account their level of self-reported experience, participants with a lower level of self-assessed knowledge and experience were likely to benefit more

from the training, which is intuitive considering the "ceiling effect", i.e. that those who are already knowledgeable and experienced may have higher scores in the pre-test questionnaire, resulting in lower levels of change being observed (Taylor, 2010). The consistency of the trend of larger improvement across professionals with the self-reported low level of knowledge and skills on CM justifies our approach to focus the training effort on professionals not specialised in CM prevention, since they are likely to have the most to learn.

The ERICA training was associated with improvements in self-reported knowledge and skills across a wide group of professionals working with children and families in different settings, i.e. schools, kindergartens, hospitals, medical centres, nongovernmental organisations, and social welfare centres. This implies that the training can have wide applicability and impact across many different professional groups and types of workplaces.

The consistency in self-reported improvement across all collaborator sites could have been a result of cultural adaptations within each site. The fact that the ERICA project included researchers from each of the collaborating countries, included cultural perspectives, which were carefully considered by each site when translating materials and adapting them to the cultural, legislative, and healthcare contexts of each site (all materials and corresponding trainer manuals are available at https://www.entermentalhealth.net/ericatraining). Potentially, a key factor in this process was close collaboration with the trainers when adapting the developed training course to each country. Data in the form of trainer feedback was gathered within each site and potentially could be analysed for further understanding of the process of cultural adaptation to the country-specific contexts, as well as facilitation of trainers' experiences, especially such key aspects as lived experience. This process of adaptation should be noted as a consideration for using the ERICA training programme within countries outside of the collaborator sites, as well as for potential re-adaptations needed in the future to account for changes in societal and legislative contexts.

Nonetheless, there are some limitations to our evaluation of the ERICA training programme. Our sample was limited to individuals who provided both pre- and post-training data, which affected the representativity of the training experience and self-reported improvement in knowledge and skills. It is possible that participants who did not respond to the post-training questionnaire were those who perceived ERICA training as the least useful. In addition, participants may have become familiar with the assessment questions, leading to a potential testing effect that could artificially inflate self-assessed improvements in post-training performance. Given that estimated cross-loadings may undermine the interpretation of the latent dimensions, we also acknowledge that additional, more diverse data may be needed to achieve more distinct and coherent component structures. Moreover, given the pre–post-design without a control group, other external factors may have influenced the results. On the other hand, though the ERICA model was nested in its indispensable adaptation to an e-learning mode representing a novel interactive approach (Crocamo et al., 2022), the smaller sample size was partly a result of the COVID-19 pandemic, which provided a challenging backdrop, thus making it both more difficult to recruit and engage the targeted professionals (many of whom were already overstretched),

and more likely attrition at the evaluation stage (Crocamo et al., 2021). In future, considering that professionals might potentially struggle to find time to fill in the post-training questionnaire, questionnaire response time should be included within the scheduled training time, or potentially paper copies of the questionnaire can be handed out if the training is being adapted to face-to-face delivery. Another limitation to our findings is that the sample size varied across collaborating countries where the ERICA training programme was piloted. This potentially altered the representation and relative contribution of each country within the overall analysed participant sample. Indeed, the unbalanced distribution of participants across countries had an impact on potential cross-national comparisons, thereby adding complexity to data interpretation. However, we considered this limitation during our analysis process, and when we explored the effects on the level of each country, consistent improvements were observed (Supplementary Material 6). For future use of ERICA training, it might be useful to consider country-specific improvements provided in SupplementaryMaterial 6 and explore the potential need for further cultural adaptations of the ERICA training programme materials, ideally with larger samples from each country.

In addition, the professional composition of trainees in some countries was skewed towards particular occupations (e.g. teaching or medical staff), some of whom might have had more prerequisite CM training. Moreover, due to the specific design and aforementioned issues, the study did not include a control group. Therefore, we could not assess whether other unmeasured factors potentially influenced our findings. Similarly, we acknowledge the need for complementary, objective measures, including knowledge gain and actual practice change, in order to provide a more comprehensive assessment of the ERICA programme's impact.

Conclusions

This ERICA digital training programme addressed an established gap in awareness and capacity on the topic of child maltreatment among non-specialist professionals working with children across Europe. This evaluation shows that a 2-day online programme had overwhelmingly positive effects, regardless of professional background or level of knowledge prior to training. Further, the self-assessed improvement in knowledge and skills was found consistently across the seven collaborator countries, thus suggesting cultural transferability. While we acknowledge the limitations of our study and the need for objective measures for knowledge and skills improvement, our findings call for further research and programme development for non-specialist professional groups. In fact, these groups of professionals, previously somewhat overlooked in child protection efforts, due to their position of regular contact with children and their families, are ideally placed for the first response to and prevention of child maltreatment.

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Data Availability The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request. Data are located in controlled-access data storage at University of St Andrews.

Declarations

Conflict of Interest The authors declare no competing interests.

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