Cost-Utility Analysis of Trauma-Focused

Cognitive Behavioral Therapy (TF-CBT):

A Randomized Controlled Trial among Adolescents with Post-traumatic Stress Disorder

Abbreviated title:

Cost-Utility Analysis of Trauma-Focused Cognitive Behavioral Therapy (TF-CBT)

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Abstract

Background; A large number of children and adolescents experience traumatic events every year. Left untreated, such events can negatively affect both their psychological and social well-being and result in high costs for society. The main objective of this paper is to evaluate whether trauma-focused cognitive behavioral therapy (TF-CBT) is a cost-effective alternative to standard treatment (TAU). We further explore whether resource use and health outcome are associated with individual and family characteristics.

Methods; Individual level data from a randomized controlled trial (NCT00635752) of 156 youths from 10 to 18 years of age provided information on health related quality of life (HRQoL), resource use, and patient and family characteristics. The data were collected between April 2008 and July 2013. The health outcome was measured by the 16D HRQoL instrument that was used to estimate quality-adjusted life-years (QALYs), while the costs were estimated by measuring minutes spent in therapy. The cost-utility was measured by the incremental cost-effectiveness ratio (ICER), which expresses the ratio of differences in resource use and QALYs gained. By means of bootstrapping, the likelihood of TF-CBT being cost-effective according to increasing threshold values for a QALY gained was displayed by the cost-effectiveness acceptability curve (CEAC).

Results; HRQoL increased for both treatment groups and there are no significant differences in QALYs. Resource use is significantly higher in the TF-CBT group for minutes per session, while total minutes of therapy are significantly lower in this group. Also, the utilization of other resources, such as psychological counseling services, welfare services and medication, are lower in the TF-CBT group post-treatment. The likelihood of TF-CBT being cost-effective varies from 86% to 95% depending on the threshold value for a QALY gained.

Conclusions; TF-CBT is likely to be cost-effective and hence should be implemented as guideline treatment for adolescents with post-traumatic stress disorder.

Keywords: e

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TF-CBT – trauma-focused cognitive behavioral treatment

TAU- treatment as usual (standard care)

HRQoL – health related quality of life

QALY – quality-adjusted life-years

ICER – incremental cost-effectiveness ratio

CEAC – cost-effectiveness acceptability curve

Introduction

A large number of children and adolescents experience traumatic events every year (Copeland, Keeler, Angold & Costello, 2007; Finkelhor, Turner, Shattuck & Hamby, 2013; Trickey, Siddaway, Meiser-Stedman, Serpell & Field, 2012; Alisic, Boeije, Jongmans & Kleber, 2011; McLaughlin et al, 2013). Left untreated, such events can negatively affect both their psychological and social well-being (Costello, Erkanli, Fairbank & Angold, 2002; Fairbank & Fairbank, 2009)

The most commonly studied psychological distress reactions after exposure to traumatic events are post-traumatic stress (PTS) reactions, which have been reported by children exposed to different types of traumatic events (Connolly, McClowry, Hayman, Mahony & Artman, 2004; Goenjian, Steinberg, Fairbanks, Alvarez & Pynoos, 2001; Kilpatrick et al, 2003). Anxiety and depressive reactions (Müller et al, 2014) together with behavioral problems (Gilbert et al., 2009) are also frequently reported in children exposed to traumatic events.

Given the complexity of symptom development and functional impairment in the aftermath of traumas, gaining more knowledge about consequences of traumatic events and how best to treat the affected children are essential. Major depression has been, in the Global Burden of Disease Study 2013, identified as one of the diseases leading to the greatest reduction in years lost (Global Burden of Disease Study 2013 Collaborators, 2015). Several studies have estimated the long-term burden of mental health problems in childhood (Knapp et al, 2014; Scott, Knapp, Henderson & Maughan, 2001; Brimblecombe et al, 2015; Ferry et al, 2015). In addition to the individual suffering and reduction in life quality, child mental health problems also represent a societal problem. Scott et al. (2001) found the financial costs of social exclusion to be about £70 000 for children with conduct disorder. Ferry et al. (2015) has estimated the economic burden of post-traumatic stress disorder for an adult population (above 18 years) in Northern Ireland, and found that the costs (both direct and indirect) per individual with 12-month PTSD were about £87 000. All these studies indicate substantial costs related to mental health diseases. It therefore seems that effective treatments will both help the individual child in terms of increased health-related quality of life (HRQoL), and could reduce utilization of health care and costs for society.

Trauma Focused Cognitive Behavioral Therapy (TF-CBT) is a component based therapy model that was developed by Judith Cohen, Anthony Mannarino, and Esther Deblinger (2006) to help traumatized children and adolescents. TF-CBT has been shown to be effective in reducing trauma-related symptoms among children and adolescents in several randomized controlled trials, and the treatment meets the well-established criteria for evidence-based practices (Silverman et al, 2008; Ramirez de Arellano et al, 2014). Follow-up studies have further shown that the treatment gains are maintained (Cohen, Mannarino, & Knudsen, 2005; Deblinger, Mannarino, Cohen, & Steer, 2006). However, to our knowledge, only one study has investigated the health economics of the treatment model, and conducted a cost-utility analysis of TF-CBT. Gospodarevskaya and Segal (2012) analyzed the cost-utility of TF-CBT and TF-CBT in combination with selective serotonin reuptake inhibitor (SSRI) among sexually abused children with PTSD. In this study, TF-CBT alone and in combination with SSRI was shown to be cost-effective compared to no treatment or non-directed counseling.

No studies have evaluated the cost-utility of TF-CBT compared to treatment as usual among a mixed trauma population of children and adolescents in regular practice. The main objective of this paper is thus to evaluate whether TF-CBT is a cost-effective alternative to standard treatment. The results will have an impact on whether TF-CBT should be implemented as guideline treatment for children and adolescents with post-traumatic stress disorder (PTSD).

Data and method

Sample and intervention

A total of 156 youths participated in the study (ClinicalTrial.gov NO00635752), of which 123 were included in this study and 33 excluded, as they dropped out of treatment within the first four weeks. In the total sample (#156), the majority were girls (*n* = 124, 79.5%) with a mean age of 15.1 years (*SD* 2.2, range 10–18) at enrollment. They were multi-traumatized, having been exposed to 3.6 (*SD* = 1.8, range 1–10) different types of traumatic events, on average. Regarding their worst trauma, most of the children/adolescents (*n* = 48, 30.8%) reported being physically abused or being exposed to domestic violence, and almost as many reported sexual abuse (*n*=27, 27.3%). Characteristics of the included sample of youths are presented in Table 1. We see that the two treatment groups are quite similar, and that the included sample does not deviate from the total sample (#156).

[Table 1 here]

All data were collected between April 2008 and July 2013. Participants were assessed pretreatment (T1), after 6 sessions of treatment (T2), post TF-CBT treatment/after 15 sessions (T3), follow up 1 year after T1 (T4) and follow-up 1.5 years after T3 (T5). The participants were referred to the community clinics according to regular practice (i.e. by their general practitioners or Child Protective Services). The study's inclusion criteria were experience of at least one potentially traumatic event at least 4 weeks before the screening, suffering from significant PTS reactions, and being between 10 and 18 years old. The exclusion criteria were acute psychosis, active suicidal behavior, intellectual disability, or nonproficiency in the Norwegian language. A randomized controlled design was used in which eligible children were randomly allocated to receive either TF-CBT or TAU. At each clinic, a computer-generated, randomization procedure allocated participants into random blocks of four or six in random order with an equal probability of four or six (for a detailed description of the study see author's own paper – masked for review purposes)

TF-CBT builds on principles from cognitive, behavioral, interpersonal, and family therapy as well as trauma-specific interventions. It is a short-term intervention, consisting of 12–15 sessions, and comprises several components. The first four components are skill-building components: Psychoeducation, relaxation, affective modulation skills, and learning cognitive coping skills. The next components relate to processing: Exposure through the trauma narrative, in vivo mastery of trauma reminders, and cognitive processing and restructuring. The last component relates to consolidation, during which the therapist helps the child or adolescent to enhance safety and works on future development (Cohen et al, 2006). Parents are involved in each of the treatment components, in both parallel and conjoint sessions, where the aim is to improve parenting skills and communication in the family. Because of this parallel involvement of parents, each therapy session is typically longer than in standard treatment (90 min. vs. 60). There were 26 trained TF-CBT therapists who provided TF-CBT. In the TAU condition, therapists provided the treatment that they believed would be most effective and suitable for the particular case. The majority of the TAU-therapists described their theoretical orientation as psychodynamic (45.9%), but many also described themselves as cognitive-behavioral (29.7%) or family/systemic therapists (24.3%). There were 45 therapists involved in providing the TAU treatment (for more details see Author's own publication: Masked for review purposes).

Health outcome

The main health outcome in this study was the generic health related quality-of-life (HRQoL) measure 16D, a secondary outcome in the trial. In addition, we included the primary endpoint the disease specific measure Child PTSD Symptom Scale (CPSS) (Foa, Johnson, Feeny, & Treadwell, 2001).

The 16D instrument is a generic HRQoL measure for youths aged 12–15 years (www.15d-instrument.net). The 16D is one of two (17D) multi-attribute generic self-assessment measures for youths, and is an adjusted version of the adult 15D measure (Apajasalo et al, 1996). 16D captures 16 dimensions: mobility, vision, hearing, sleeping, eating, speech, elimination, usual activities, friends, physical appearance, mental function, discomfort and symptoms, depression, distress and vitality. For each dimension, there are five alternative responses, ranging from no problems to severe problems.

The 16D had not been applied in a Norwegian setting prior to this study; hence, we had to translate the questionnaire. The translation was carried out according to the standards given by the Finnish 15D organization (www.15d-instrument.net). It was organized in collaboration with the clinicians running the trial, the health economists involved in the study and English and Norwegian-speaking persons. Even though the questionnaire is generic, we involved the clinicians in the study as they had valuable knowledge about children and youth and their cognitive understanding. The translation comprised several steps: Firstly, a forward translation (the first Norwegian version) of the questionnaire was developed based on the English questionnaire. The translation was carried out by the clinicians, the health economists and an English speaking person. Secondly, the Norwegian version was backward translated by two independent persons, not involved in the first step. The backward translated questionnaire was compared with the original questionnaire. Based on this comparison, only minor adjustments were needed. Lastly, we tested the questionnaire on a small sample of Norwegian youths, and it was concluded that no changes in the questionnaire were needed. The final version was then accepted by the Finnish 15D organization.

The patients included in the study reported along all 16 dimensions at all observation points (baseline, T2, T3, T4 and T5). Based on these responses, we calculated HRQoL at each observation point. HRQoL is constructed by combining weights for each category and dimension into a single HRQoL index. The HRQoL single index is between 0 (referring to death) and 1 referring to perfect health (no problem on all dimensions). The weights are based on a valuation from a population-based preference study in Finland (Apajalso et al., 1996). The population contained a sample of 12–15 year-old school children (Finnish population).

In addition to HRQoL, we applied the disease specific measure, CPSS (Foa et al., 2001). The CPSS is a self-report questionnaire designed to assess the post-traumatic stress symptoms (PTSS) for children and adolescents between 8 to 18 years described in the *Diagnostic and Statistical manual of Mental Disorders (DSM-IV)* (American Psychiatric Association, 1994) The CPSS has 17 items scored on a 4-point Likert scale: 0 (not at all), 1 (once in a week or less/once in a while), 2 (2–4 times a week/ half the time), and 3 (5 or more times a week/ almost always).

The maximum total score of CPSS is 51, adding responses (0–3) on all 17 questions. The cut-off score of 11 was originally used to distinguish those with low vs. high PTSD symptoms (Foa et al., 2001), but a cut-off score of 15 has later been suggested to be more appropriate (Kassam-Adams, Marsac, & Cirilli, 2010). In this study, the inclusion criteria was a score of 15 or more (See author's publication).

Resource use

Direct and indirect resources were registered, where direct resources represent the time the therapist spends in therapy sessions with the child and/or parent, measured in minutes. Indirect resources are related to the use of resources elsewhere, such as use of the school psychological counseling service (PPT) and social welfare services. For each patient, a random selection of sessions were measured in number of minutes (*minutes per session*). Minutes per session were set to the sample mean minutes per session for 19 patients without registrations of minutes per session. In addition, 11 patients in the TAU group had two therapists involved during each session and this was accounted for. Hence, the mean number of therapists during a session (*therapists per session*) was greater in the control group compared with the treatment group. The total number of minutes in therapy was calculated as: *total minutes* = *minutes per session* * *therapists per session* * *total no. of sessions*. Registration of indirect resource use prior to treatment and during treatment was based on forms filled in by the caregiver. These registrations were limited to recording whether or not the child or adolescent had received different types of services. The services included in the form were educational and psychological counseling service (PPT), child welfare services, services from Norwegian labor and welfare administration (NAV), school nurse, rehabilitation team and other services. In addition, we registered whether or not the child used any type of medicines.

Resource-utility analysis

Economic evaluation of TF-CBT consists of simultaneous comparison of resource use and health outcomes. The analysis of resource use and health outcomes is presented by the incremental cost-effectiveness ratio (ICER) (Drummond et al., 2005), defined by:

$$ICER = \frac{(Total\ no\ minutes\ in\ thereapy\ TF - CBT) - (Total\ no\ minutes\ in\ thereapy\ TAU)}{(QALY\ TF - CBT)\ - (QALY - TAU)} = \frac{\Delta C}{\Delta E}$$

where ΔC and ΔE are incremental resource use (measured in minutes) and incremental QALYs, respectively. The ICER expresses minutes in therapy per QALY gained. If TF-CBT implies less minutes in therapy than TAU and greater health outcome, TF-CBT is a dominant strategy, while if number of minutes in therapy is higher in TF-CBT and the health outcome is lower, TF-CBT is dominated by TAU. In a situation where TF-CBT implies a higher number of minutes in therapy and higher health outcome compared to TAU, the preferable strategy will depend on how much we value a QALY gained, often referred to as the threshold value. It is important to note that a negative ICER is ambiguous to interpret, as a negative sign could both stem from the intervention being resource-saving (-ΔC) and from a decline in QALYs gained (-ΔE). To handle this, the results could be presented by the Net Monetary Benefit (NMB) given by: NMB = λΔE - ΔC, where λ is the threshold value for a QALY gained. When NMB >0, TF-CBT is the preferred strategy.

Statistics and analysis

A power analysis was performed prior to recruitment. Using an estimated difference between intervention and control groups of approximately 0.5 SD and requiring a power of 0.80 and α = .05, this analysis showed that 62 participants were required in each treatment group.

Arithmetic means of effect were calculated at each follow-up with an independent *t*-test. QALYs were calculated as the area under the curve (AUC) plotting each HRQoL measurement in a time line. The effect on CPSS is estimated as the reduction in the CPSS score from baseline to T5. Differences in resource use are both explored by *t*-tests.

Missing values were partly replaced. For HRQoL and CPSS, we assumed that if one person had a missing observation between two observations points, the relationship between these two observation points was assumed to be linear. For T5, the linear trend from observation point T3 to T4 was carried onwards to T5.

For resource use, information on the variable '*minutes per session'* had several missing observations. We adjusted this by replacing '*minutes per session*' with mean '*minutes per session*' when '*minutes per session*' was missing.

In the sensitivity analysis related to the resource-utility analysis, heterogeneity in the composition of patients with regard to resource use and health outcome was explored. As cost-effectiveness is often skewed, the non-parametric bootstrap method was chosen to illustrate the heterogeneity. The bootstrap method is applied to create new samples (1,000 samples) by drawing a random sample with replacement and constructing a given number of equally sized resamples of the existing dataset (Glick, Doshi, Sonnand & Polsky, 2015). The mean from the 1,000 new samples is plotted in a cost-effectiveness plane. Based on the scatterplot, we plot the cost-effectiveness acceptability curve (CEAC) that represents the probability that TF-CBT and TAU are cost-effective given increasing threshold values for a QALY gained.

Results

Health outcome

Differences in 16D scores and CPSS were tested at each observation point and are reported in Table 2. At T3 (after 15 therapy consultations, approximately 7 months after inclusion) the patients in the TF-CBT group report a significantly higher 16D score and a significantly lower CPSS score than the TAU group. For the QALY estimates (1.574 for TF-CBT and 1.528 for TAU, *p*=0.209), there were no significant differences between the groups. The reduction in CPSS scores from baseline to T5 was not significantly different between the groups (-15.78 for TF-CBT and -13.27 for TAU, *p*=0.341).

Resource use

From Table 2, we see that there were more minutes per session in TF-CBT compared to TAU. However, there were fewer sessions, and fewer therapists per session, in TF-CBT compared to TAU. Altogether, mean total minutes spent in session were 22 percent less in the TF-CBT group than in the TAU group. Also the number of sessions used to cooperate and coordinate the treatment with other providers is smaller in the TF-CBT group than in the TAU group.

[Table 2 here]

We have also compared use of other services between groups. Since there are some missing observations at T5, we compared T4 and T1 across groups. Results are shown in Table 3.

[Table 3 here]

The TF-CBT group experiences a considerable reduction in the use of PPT services and in the use of child welfare services. The reductions in the TAU group are smaller. The same applies to the use of social services and medication use. Overall, there is a tendency toward a greater reduction in use of services in the TF-CBT group relative to the control group. A problem with the indirect resource use data is the high proportion of missing observations. However, we have no reason to believe that there are different reasons for missing observations in the two groups.

Resource-utility

From Table 4, we see that total QALYs over the two year-period were higher for the TF-CBT group than for TAU (1.574 and 1.528, respectively), which gives an incremental health gain of 0.046 (1.574 - 1.528). The magnitude of this health gain was higher than that recently stated as being a minimum important change for 15D (Alanne, Roine, Räsänen, Vainiola & Sintonen, 2014).

The incremental resource use was 348 minutes less in the TF-CBT group (1,467 minutes on average) than in the TAU group (1,815 minutes on average). The ICER of –7,565 can be interpreted as the reduction in minutes per QALY gained (-348/0.046), meaning that for every QALY gained there is a resource saving of 7,565 minutes of therapy (126 hours of therapy). When incremental health was measured by changes in CPSS scores, the ICER was 140 (-348/-2.51), indicating that TF-CBT both reduced the resource use and increased health gains.

[Table 4 here]

The children and adolescents included in this study were not a homogeneous group, and varied both according to background characteristics, but also with regard to QALYs and resource use. To explore this heterogeneity, we used 1,000 bootstrap simulations to create a new sample containing mean QALYs and resource use estimates for each bootstrap simulation according to TF-CBT and TAU. The result of the bootstrap procedure is illustrated in Figure 1. In Figure 1, TAU is located in origin, thus all dots refer to the 1,000 ICER estimated by the bootstrap simulations, i.e. incremental minutes in therapy per QALY gained. The 1,000 simulations are allocated in one of the four quadrants in Figure 1 (I, II, III and IV). If all the simulations are allocated in Quadrant II, TF-CBT implies less use of resources (reduction in minutes in therapy) and QALYs gains compared to TAU, and TF-CBT is a dominant strategy and would be the preferred treatment option. If instead all the simulations are allocated in Quadrant IV, TF-CBT would imply higher use of resources (increased minutes in therapy) and QALYs lost, which implies a situation where TF-CBT is dominated by TAU; and TAU will be the preferred treatment option. Further, simulations in Quadrant I imply that TF-CBT has higher use of resources and QALYs gained, while simulations in Quadrant III have the opposite implication. For a situation where all the simulations are allocated in Quadrant I, whether TF-CBT would be recommended as the preferred treatment option depends on the threshold for a QALY gained. The threshold is the value for a health gain, such as QALY. In Figure 1, the simulations are distributed in all four quadrants, were the majority of 77.7% were allocated in Quadrant II (resource saving and higher QALYs), while 12.3% in Quadrant I (higher use of resources and higher QALYs), 9.4% in Quadrant III (resource-saving and lower QALYs) and about 0.6% in IV (higher use of resources and lower QALYs). Based on these numbers, we see that about 87% of the simulations imply that TF-CBT is resource-saving (II and III), and 90%

of the simulations imply that TF-CBT provides higher health gain (I and II). Based on the scatterplot, we have estimated the two cost-effectiveness acceptability curves (CEACs) according to intervention group. The probability that TF-CBT is a cost-effective alternative is 0.87 at a zero threshold for a QALY gained (sum of Scatterplots I and II), implying that there is no value to health forgone (QALYs), and resource use is superior to health gain in the decision for the intervention, which is considered the optimal choice. For gradually increasing thresholds, the probability of TF-CBT to be cost-effective increases until the threshold is about €8000, before it declines and converges to 0.90 (I and II). When the threshold increases to infinity, the decision-makers have health gain as the superior criteria for decision making, and resource use has no weight in the decision.

[Figure 1 here]

Discussion

In this study, we found that both TF-CBT and TAU increase HRQoL for children and adolescents with PTSD. The increase was greater for TF-CBT, and was significantly different at T3 (after 15 therapy consultations in the TF-CBT), but was not significantly different from TAU at the last measurement point or for QALYs gained. With regard to resource use, TF-CBT implied a significantly lower use of resources, measured by minutes of therapy, compared to TAU. When these findings were combined in the resource-utility analysis, we found that for every QALY gained, about 126 hours of therapy is saved. Based on the sensitivity analysis, depending on the threshold for a QALY gained, the likelihood of TF-CBT being cost-effective varies between 0.87 and 0.95. The use of other services, such as welfare services and school nurse, were also lower for the TF-CBT group compared to TAU.

To our knowledge, there are no studies of the cost-effectiveness of TF-CBT compared to TAU for a general PTSD population, with information on resource use and HRQoL within the same study. Gospodarevskaya and Segal (2012) found that TF-CBT alone and in combination with SSRI were cost effective alternatives to no treatment, and dominated non-directed counseling. Based on the mean estimates, our analyses also show that TAU is dominated by TF-CBT in a sample of multi-traumatized youth.

In the literature, it has been argued that any differences in baseline HRQoL should be adjusted for in the cost-utility analysis by adjusting the area under the curve by baseline HRQoL (Manca, Hawkins & Sculpher, 2005). When adjusting for differences at baseline in our analysis, the incremental health gain declines slightly, but did not change the overall conclusion with regard to cost-effectiveness.

Our analysis suggests that TF-CBT should be included in the guidelines as a better alternative than the current standard care (TAU). If TF-CBT is going to be the new standard care for children and adolescents with PTSD, therapists need to be trained in the therapy method. The cost of training is not included in this analysis. Therefore, when implementing TF-CBT on a wider scale, this needs to be considered. Inclusion of the cost of training should be the incremental difference of training in TF-CBT and regular training in treatment as usual.

The time perspective between baseline and the last follow-up measurement point is approximately two years. A longer follow up period would have given us the opportunity to study whether the effect on health gain is persistent, which would strengthen our results. From our data, we see that the main health gain is derived at the beginning of the treatment, indicating that TF-CBT implies an earlier increase in health than standard treatment. In addition, treating these patients with TF-CBT releases resources that can be used elsewhere. Given a persistent health gain, the potential cost savings could be even greater if the long term consequences on social welfare and need for health care services responds to this difference in health. We know from work by Knapp et al. (2014) that a considerable part of costs related to mental health problems are outside the health care sector. One study that examined the long-term effect of violence and/or bullying at 15 years of age found that this form of victimization predicted negative work participation outcomes eight years later, independent of high school completion and other relevant factors (Strøm et al, 2013). In future research it would be interesting to analyze the long term consequences for youths experiencing other types of trauma on working status and need for social welfare.

In this study we applied the 16D questionnaire developed for the age group 12 to 15 years, which did not perfectly fit the age group of our study (age range: 10–18 years). However, we decided to apply only the 16D, for practical reasons, as it would have required more administration to handle three questionnaires (15D and 17D in addition to 16D). A limitation would be that the youngest and the oldest would not feel familiar with the formulation of the questions, and therefore respond wrongly due to misunderstandings. This could potentially give wrong answers, but it is not likely to affect the two groups differently as the age range is similar in the two groups.

In the study, 156 children and adolescents were included, while only around 90 were included in the cost-utility analysis with partial replacement of missing values (both resource use and HRQoL). Among those not included in the analysis, 33 dropped out before they had ended the sixth therapy session. Of the dropouts, 14 (18%) were included in the TF-CBT group and 19 (25%) in the TAU group. A higher dropout rate in the TAU group could affect the findings due to selection bias, but the consequences are ambiguous with regard to the cost-effectiveness of TF-CBT. First, if the most difficult cases drop out, this would imply that the effect of TF-CBT was underestimated, as the proportion of difficult cases was higher in the TF-CBT group included in the analysis. Secondly, if the dropouts left because they needed less therapy and generally had a higher health outcome, then the incremental QALY gained in our study was overestimated. However, analyses show that there were no significant differences in mean T1 symptom scores between those who dropped out during the first four weeks in TAU compared to those who continued (mean CPSS T1 in dropout-group: 27.0 vs continuers: 26.9, $t(1, 46.8) = -0.04$, $p = .961$; mean MFQ T1 in dropout-group: 34.6 vs. continuers: 35.6, $t(1, 75) = 0.26$, $p = .796$; mean SCARED T1 in dropout-group: 30.6 vs. continuers: 34.2, $t(1, 74) = 0.82$, $p = .413$). This pattern was found also in the TF-CBT group (mean CPSS T1 in dropout-group: 28.2 vs continuers: 26.9, $t(1, 77) = -0.61$, $p = .546$; mean MFQ T1 in dropout-group: 37.7 vs. continuers: 34.9, $t(1, 77) = -0.80$, $p = .427$; mean SCARED T1 in dropout-group: 34.4 vs. continuers: 34.1, $t(1, 73) = -0.06$, $p = .953$), indicating that the dropouts and continuers were comparable in terms of their need of treatment in both conditions. In addition to the dropouts, several participants did not complete the questionnaires, which could influence the cost-utility in our analysis.

In this analysis, we used direct resource use, measured by time in therapy instead of costs. As all measures for resource use indicated less use in the TF-CBT group, we considered it unnecessary to adjust with a unit price for therapy. Including the unit price would scale up the findings, but would not change the overall conclusions, as the cost-effectiveness acceptability curve is quite stable according to threshold values for a health gain. Other services were not included in the cost-utility analysis due to missing values at T5. If the resource use of these services had been included, this would have strengthened the conclusions.

As pointed out earlier and by several authors (Knapp et al, 2014; Scott, Knapp, Henderson & Maughan, 2001; Brimblecombe et al, 2015; Ferry et al, 2015), costs and consequences of mental health do not only occur in the health care sector, but also affect families and friends and other sectors, such as social services and schooling. As costs and consequences outside the health care sector are not accounted for, the total costs and savings for treating children with PTSD were not captured in this study. Further, if the differences in health are persistent over time, the cost saving could be underestimated for the TF-CBT group.

Conclusion

Based on the findings in this study, treating youths with trauma focused cognitive behavioral treatment (TF-CBT) is likely to be a cost-effective alternative to standard treatment among adolescents with post-traumatic stress disorder, when resources are defined by minutes in therapy. For other use of resources, such as welfare services and school nurse, TF-CBT implies less use. Measures should be taken to include this treatment as part of guidelines.

Key points:

- Even though TF-CBT is in several studies shown to have a positive clinical effect on adolescents with post-traumatic stress disorder, the cost-effectiveness of TF-CBT compared to treatment as usual not yet determined for a general adolescent population.
- Little is known about health related quality-of-life (HRQoL) among adolescents with post-traumatic stress disorder and differences between TF-CBT treatment and treatment as usual (TAU).
- Resource use for both TF-CBT and TAU is identified and we find that number of minutes in therapy is significantly lower for TF-CBT.
- Based on our findings, TF-CBT is likely to be a cost-effective alternative for TAU.

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Table 1: Characteristics of the sample according to treatment groups, proportions unless other stated (no. included 123 without dropouts)

Variable	TF-CBT	TAU
Age (*mean, st.dev)*	14.9 (2.17)	14.8 (2.16)
Trauma *(mean, st.dev)*	3.6 (1.56)	3.5 (1.87)
MFQ* inclusion *(mean, st.dev)*	34.9 (11.9)	35.6 (13.6)
SCARED inclusion *(mean, st.dev)***	34.1 (16.0)	34.2 (17.2)
Gender		

	Girls	0.25	0.16
	Boys	0.75	0.84
Ethnicity			
	Norway	0.72	0.74
	Other	0.28	0.26
Household income (NOK)			
	200 000 - 500 000	0.16	0.18
	500 000–1 000 000	0.35	0.43
	>1 000 000	0.37	0.32
	Don't know	0.12	0.07

*MFQ a disease-specific measure for depression, **SCARED is a disease-specific measure for anxiety

Table 2: Health outcomes and resource use according to observation period and treatment group, testing for differences in mean values (st.dev).

Variable (# obs TF-CBT/TAU)	TF-CBT (st.dev)	TAU (st.dev)	*t*-test (*p*-value)
16D – baseline (64/56)	.759 (.012)	.769 (.104)	.620
16D – T2 (62/58)	.807 (.117)	.785 (115)	.288
16D – T3 (56/55)	.869 (.118)	.818 (.119)	.030
16D – T4 (47/48)	.876 (.101)	.849 (.107)	.224

16D – T5 (45/47)	.881 (.109)	.863 (.102)	.442
QALYs (44/45)	1.574 (0.177)	1.528 (0.164)	.209
CPSS – baseline (65/57)	26.88 (0.93)	26.86 (1.12)	.992
CPSS – T2 (62/60)	19.09 (1.38)	21.12 (1.52)	.322
CPSS – T3 (55/55)	11.61 (1.43)	17.43 (1.58)	.007
CPSS – T4 (47/49)	11.81 (1.44)	14.62 (1.74)	.219
CPSS – T5 (45/47)	11.14 (1.75)	13.41 (1.81)	.371
Change CPSS (baseline to T5)	-15.78	-13.27	.341
Total sessions (65/58)	18.74 (9.33)	26.48 (21.32)	<.000
Therapists per session (65/58)	1 (0)	1.17 (0.38)	-
Minutes per session (54/50)	75.91 (22.41)	53.22 (16.09)	<.000
Total minutes (65/58)	1393.01 (789.15)	1773.21 (1987.31)	.004
Coordination sessions (65/52)	1.85 (3.06)	3.29 (5.88)	<.000

Table 3. Proportion of individuals with use of other services and medicines at T1 and T4 according to group (# observations).

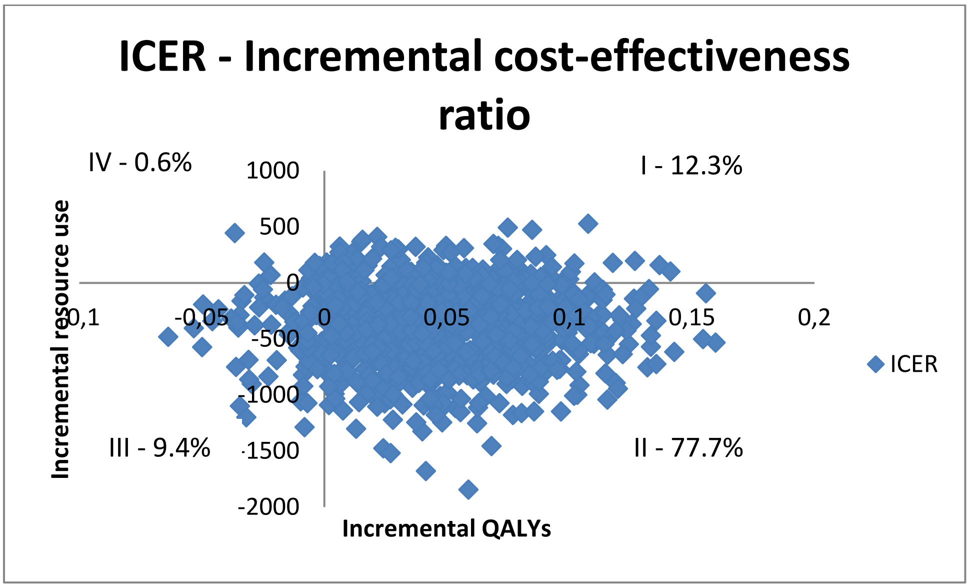
Type of service	**TF-CBT**		**TAU**	
	T1	T4	T1	T4
PPT	0.21 (62)	0.15 (39)	0.12 (50)	0.10 (31)
Child welfare services	0.29 (62)	0.18 (39)	0.30 (50)	0.27 (33)
Social service (NAV)	0.13 (62)	0.05 (39)	0.08 (50)	0.10 (31)
School nurse	0.24 (62)	0.10 (39)	0.36 (50)	0.19 (32)

Rehabilitation team	0.08 (48)	0.13 (30)	0.11 (44)	0.08 (25)
Other services	0.15 (62)	0.15 (39)	0.12 (50)	0.13 (31)
Medication	0.28 (60)	0.19 (37)	0.31 (49)	0.29 (34)

Table 4: Incremental cost-effectiveness ratio for TF-CBT (#44) versus TAU (#45) in a two year-perspective[a]*.*

Intervention	# minutes	QALYs	Incr.minutes*	Incr. QALYs**	ICER***
TAU	1 815	1.528			
TF-CBT	1 467	1.574	-348	0.046	-7,457

α Number of observations for both QALYs and minutes in therapy is equal to observations for QALYs, hence #minutes in therapy is different (smaller difference) in Table 4 than in Table 2, *(1,467-1,815),**(1.574-1.528) and ***(-348/0.046)



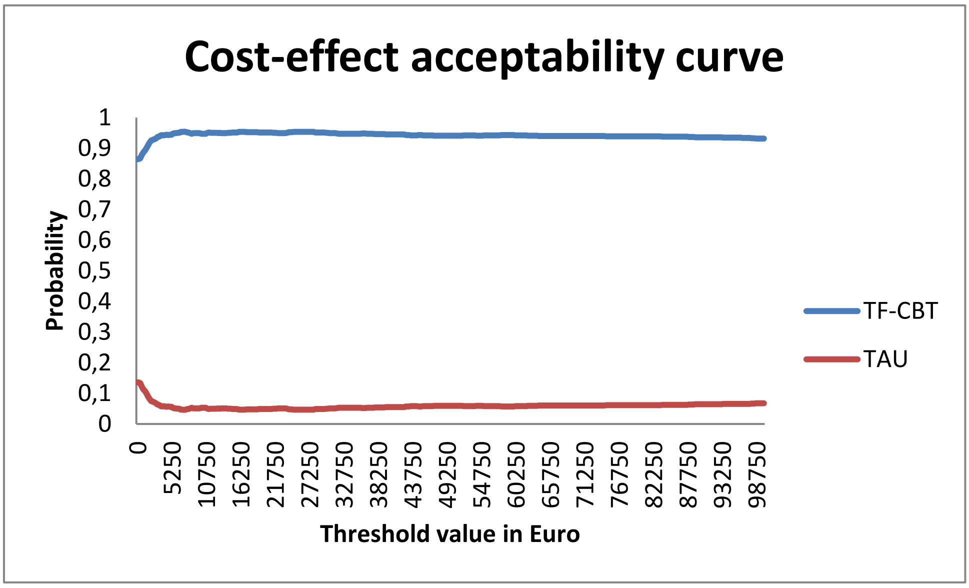


Figure 1: Scatterplot of the Incremental cost-effectiveness ratios and the cost-effectiveness acceptability curve (CEAC) with QALYs gain as output for 1,000 bootstrap simulations

Appendix

CONSORT 2010 Flow Diagram