Mental Health Outcomes 27 Years After a Major Disaster

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Abstract

In March 1980, an oil rig in the North Sea capsized with 212 men on board; 123 died and 89 survived. A research program followed up the 75 Norwegian survivors in 4 waves of data collections: shortly after the disaster (1980), after 1 year (1981), again after 5 years (1985), and eventually after 27 years (2007). In 1985, a matched comparison group was included and followed up until 2007. The comparison group was matched for age, gender, profession, and domicile. So far, this disaster study has the longest follow-up period that is combined with a comparison group.

In this chapter, a description of the disaster itself is given together with a brief introduction of disaster psychiatry, i.e., the study of civilian disasters as a part of the larger research field that is addressing post-traumatic stress.

After 27 years, no significant difference in the general symptom severity or in the number of screened cases was found between the survivors and those from the comparison group when using inventories such as PTSS and GHQ. The same was also found regarding the annual number of weeks in sick leave or disability pension; annually, there was a significant difference between the survivors and the comparison group during the first 12 years, but after that time the annual significant difference disappeared and did not return.

However, when using the SCID I interview in 2007, significant differences were found with regard to diagnoses. The risks were more than three times higher of survivors having one or more psychiatric diagnoses at that time than for those in the comparison group. The biggest difference was found for anxiety disorders, but depressive disorders also demonstrated significant differences. The most prevalent of the lifetime diagnoses was the depressive disorders, about one third of the survivors, while less than one fifth in the comparison group had faced this kind of mental health problems. Lifetime somatoform disorders were only found among the survivors. Lifetime substance misuse was significantly more prevalent among the survivors. About a quarter of the survivors had an early-onset PTSD, but the occurrence dwindled over the decades. Anxiety and depression seemed to become more common, rendering support to the suggestion that post-traumatic symptomatology in the long run may serve as a transitional psychopathology. Comorbidity was far more common among the survivors. Those reporting residual PTSD symptoms were more likely to experience reactivated PTSD later in the post-traumatic course. The reported post-traumatic growth after 27 years was highly correlated with the concurrent symptom severity, and not with higher levels of post-traumatic burden of the past. This indicates that self-reported post-traumatic growth may serve as a means of coping rather than an expression of richer and fuller lives.

List of abbreviations

DSM   Diagnostic and statistical manual
GHQ   General health questionnaire
IES   Impact of event scale

M   Mean value
NEO-PI   NEO personality inventory
PTG   Post-traumatic growth
PTGI   Post-traumatic growth inventory
PTS   Post-traumatic stress
PTSD   Post-traumatic stress disorder
PTSS   Post-traumatic stress scale (previously called Post-traumatic symptom
           scale)
SCID I   Structured clinical interview for DSM-IV
SD   Standard deviation

Disasters have always played a role in human existence. However, systematic studies of them are of recent origin. Today, disaster studies are a part of the scientific endeavor to understand how major stressors or adverse events may precipitate temporary or lasting stress responses, even psychopathology in people. The study of disasters provides an opportunity to explore how many people may be affected by one fairly unified stressor.

In the 1960s, there was a surge in research in response to the list of life events published by Holmes and Rahe (1967). Subsequently, Paykel, Brown and Harris, and others (Paykel et al. 1971; Brown and Harris 1978; Finley-Jones and Brown 1981) published their approaches to the study of such events. In retrospect, life events are often associated with the onset of somatic or psychiatric disorders, but not so in prospective studies. Far more subjects have experienced events without the onset of any health problems. For that reason, other factors seem more likely to explain the outcome.

During the 1970s, research interest shifted from life events toward major stressors or traumas outside the range of usual human experience. The major stressors were not even mentioned in the initial lists of life events. Horowitz works on the stress response syndromes (Horowitz 1976; Horowitz et al. 1979), and the introduction of the PTSD diagnosis in the DSM-III in 1980 (American Psychiatric Association 1980) in the wake of the Vietnam war played a considerable role in stimulating research on post-traumatic stress, a field in which work has since been quite prolific.

Disaster Studies

At the outset in the 1980s and early 1990s, disaster research was rare, and it was carried out in places as far apart as Australia by Beverley Raphael (Raphael 1986a, b; Raphael and Middleton 1987), Norway by Lars Weisæth (1984) and Are Holen (1990a), and the American Midwest by James Titchner (Titchner and Kapp 1976), Goldine Glaser, Bonnie Green, and others (Gleser et al. 1981). Gradually, however, disaster research developed into a field with its own methodological issues, problems, and challenges. For a review of disaster research methods, see Fran H. Norris (Norris et al. 2002a, b; Norris 2006).

In addressing disaster research, the timing of the psychological assessments is important both in terms of when after the disaster a study is undertaken, but also, if and when follow-up studies have been carried out. Norris's reviews of the field indicate that data collections have been made from quite early on until decades after the disaster. Few studies have access to relevant information about survivors from before the disaster. Most disaster studies are cross-sectional with no more than one observation point. Those having follow-up tend to carry them out after a fairly short time, usually about 1–2 years or less. Very long-term studies of disaster populations exist, but they are rare, and those that include a comparison or reference group are almost absent (Holgersen et al. 2010b, 2011). With a very long-term follow-up, many things may have affected the lives of people; a matched reference group therefore seems warranted to reduce noise.

The symptom severity of a survivor may in part be a function of the time since the disaster. Cross-sectional studies do not capture either this decline or the diversity of how people may respond over time. Looking at disaster populations as one group may not always bring out the essential differences. In the longer run, subgroup analyses seem required to capture the diversity of the postdisaster course of the survivors, and advances in statistical methodology have made such explorations simpler.

To obtain a clear-cut research design, many studies define inclusion and exclusion criteria for participation. In assessing a stressor, one criterion often used is related to the center-periphery dimension or degree of exposure. It is usually based on the location of the person during the traumatic event: was the person near or far from, e. g., the explosion? His whereabouts will decide whether he or she will be included or excluded from the study, and if included, where in the study the person will play a role. However, many disasters do not have a center-periphery dimension. All survivors from a plane crash or from a vessel that sank at sea will normally qualify equally; the surviving population as a whole is relevant for the study, provided the number of persons involved is not too small.

Disasters have been categorized in other ways, too. One helpful categorization divides disaster into natural disasters, technological disasters, and disasters due to intentional human violence, such as crime or war-related experiences. The categorization of disasters and their implications for research is still in its early stages. This is also reflected in the last three versions of the DSM systems; the stressor criterion has changed in every new edition.

North Sea Oil Rig Disaster: 27 March 1980

Before reviewing some of the main findings from the research carried out 27 years after the capsize of the oil rig in the North Sea in 1980, we will give a brief account of the disaster itself.

In Norway, the production of oil is carried out offshore. Some rigs are floating, others are fixed to the sea bottom; some are used for drilling, others for production and maintenance; some serve as dwellings or floatels. The Alexander L. Kielland rig was a big floating rig and could accommodate hundreds of oil workers. It was named

after one of Norway's classical authors, Alexander L. Kielland (1849–1906). He lived in the city of Stavanger, today considered to be the oil capital of Norway. This rig was placed on the Ekofisk field about midway between Norway and Scotland and mostly served as a floatel.

In the North Sea on 27 March 1980, the weather was very bad. The wind had a speed of 20 m/s., i.e., a near gale. The waves were 6–8 m high. The water temperature was 4 °C. Due to fog, clear sight was only 30 m. At that time, helicopters normally would not fly with less than 800 m clear sight. The Kielland rig was located adjacent to the Edda rig; the latter was fixed to the sea bottom. Under normal conditions, there was a bridge between the two, and people could walk across freely. However, during bad weather, the bridge was taken down for safety reasons, and the floating rig was pulled a certain distance away from the fixed-rig installation.

At around 6:30 PM on board the Kielland rig that day, a loud noise was heard. One of the five legs with a pontoon at the lower end broke off. Immediately, the rig tilted to an angle of 30°, and water started to pour in. Soon after, the electricity system broke down. The rig was left in darkness. The situation was chaotic. Due to gravity, containers and loose debris on the decks and inside were set in motion. Some doors got blocked. Some individuals could hardly get out of the room they were in, while others could end up under a heap of chairs, tables, etc. The launching of life boats was rather cumbersome due to the angle of the slanted rig. During the efforts to abandon the rig, some life boats were splintered when the waves knocked them against the legs of the rig. Some huge anchor wires fixed to the sea bottom kept the rig temporarily stable, but after about 40 min the weight of the tilting rig was so enormous that the huge wires broke off; it was about the time when the rig had reached an angle of about 45°. Soon after, it capsized upside down.

Due to the bad weather that day, many oil workers had not been flown out to their production rigs. Accordingly, there were far more people on the rig than usual. In total, 212 men were on board, 123 died, and 89 survived. Of them, 75 had their domicile in Norway. When it occurred in 1980, this was the biggest offshore disaster ever in terms of lives lost. Later, in July 1988, the explosion and fire on the Piper Alpha rig took over that role with 167 dead and 59 survivors (Hull et al. 2002).

Research Project

Soon after the disaster, the Norwegian government funded the first Kielland study, which gave it a flying start. A few months of planning were required, and then every Norwegian survivor was approached in person by one psychiatrist about 5.5 months on average after the disaster. The survivors underwent semistructured interviews about their individual disaster experiences, their stress responses, mental and physical health status, their job status, and social situation in the aftermath. In addition, a few standardized inventories were completed. Later Kielland studies have been supported by the Norwegian Research Council and ExtraStiftelsen.

This project had a dual aim: firstly, to check the health status of every survivor, and whenever required, offer those in need a referral to adequate medical and/or

psychiatric treatment or other kinds of welfare support; secondly, to carry out a scientific disaster study on the Norwegian survivors. Accordingly, it was both an outreach and a research program.

The Kielland study is a large disaster project, not with regard to the number of participants but in terms of research methodology and the number of follow-up studies. Many different approaches have been utilized, such as inventories, structured interviews, register data, behavioral tests, and more. In this chapter, some central findings mostly from 27 years after the disaster will be presented. There are aspects of methodology, research dilemmas, and results that have not been included here. All reported findings are taken from published papers in international peer-reviewed journals, as well as from three doctoral dissertations that have been publicly defended. Readers interested in more details about the methodological issues or results are advised to explore the original publications.

The research on the Alexander L. Kielland disaster covered in this chapter is based on data published by Hans Jakob Boe PhD, Katrine Høyer Holgersen PhD, and Are Holen MD, PhD. All are grateful for the cooperation with both the survivors from this disaster and the members of the comparison group.

Four Waves of Data Collection of Norwegian Survivors

1980	Interview + Questionnaires (completion time: 2 h)
	Survivor population: N = 75; 100 %
1981	Questionnaires; by regular mail (1 h)
	Survivor population: N = 70; 93 %
1985	Interview (3 h) + Questionnaires (1.5 h)
	Survivor population: N = 72; 96 %
	Comparison group: (N = 92; 100 %); matched and included from 1985
2007	Interview (2.5 h) + Questionnaires (1.5 h)
	Survivors population: N = 49; 65 %
	Comparison group: N = 62; 67 %
2007	Public health insurance data from 1978 to 2006: weeks of functional impairment, defined as weeks on sick leave or disability independent of diagnoses
	Survivors and Comparison group members were below age 60 to avoid regular retirement

In deciding when to carry out the data collections, times likely to precipitate anniversary reactions were systematically avoided.

Research Questions Guiding the Presentations of Findings in this Chapter

What will the changes in the post-traumatic mental health and PTSD be over the course of 27 years?

Will there be predictive links between the very early recovery slope of survivors and their later manifestations of mental health?

Are there links between residual symptoms and possible reactivation of subsequent PTSD?

Will the health difference between survivors and members of the comparison group increase, remain or decrease over the time span of 27 years?

Are there links between the self-reports on post-traumatic growth in 2007 and the survivors' previous levels of post-traumatic stress?

Design

The Kielland study is a longitudinal and prospective case-control study of survivors from an oil rig disaster in the North Sea with a matched comparison group.

Note on Participants

Of the total of 89 survivors, the 75 survivors with their domicile in Norway were included in the research project. The 14 survivors who did not live in Norway originated from 5 different countries. To avoid possible "noise" in the data due to languages and cultural differences, they were excluded from the scientific part of the project. The mean age of the survivors at the time of the disaster was 35 years. Over the 27 years, some had died, a few were so reduced in health and strength that they were unable to participate, and some declined, but all along, the level of participation remained quite high. The part of the data collection that involved the completion of inventories always had slightly lower participation rates than interviews; a common explanation often given by the participants who did not complete the questionnaires was "Too much to read."

In 1985, a matched comparison group was also included (n = 92). They were matched for gender, age, profession, and domicile. Women were not allowed to work offshore at the time of the disaster in 1980. Accordingly, the matched group included only men. They were all offshore oil workers connected with the Ekofisk fields in the North Sea. They had been employed in accordance with the same selection criteria with regard to health status, competencies, and training for licensure to work offshore.

It was assumed that the decline in their participation would be larger than among survivors. Accordingly, oversampling was done. Several of the interview issues from prior studies were repeated in the later studies. In addition, every new wave of data collection added some new tools. In 2007, 27 years post trauma, the survivors and those in the comparison group who were willing and able were approached for informed consent and research.

Standardized Tools Relevant for Data Collection of this Chapter

GHQ-20	The version had 20 items; it is taken from the General Health Questionnaire (GHQ). All items have four scoring options; the 0-0-1-1 scoring option and the 3/4 cut-off point were used in this study
IES-15	Impact of Event Scale (15 items); each item is normally scored 0–5. The sum of 7 items gives the Intrusion subscore and the sum of 8 other items gives the Avoidance subscore. In addition, a total score with the sum of all 15 items was used as well. Another way of scoring the IES items was also used in this study to approximate the degree of residual symptoms present in the survivors
NEO-PI	NEO Personality Inventory – short version of 60 items, 12 items for each of the 5 traits: Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Only the trait called Neuroticism was used. Neuroticism indicates a propensity for dysphoric affect and an apprehensive expectation toward life
PTGI	Post-Traumatic Growth Inventory; this is a 21-item, self-administered instrument with 5 subscores: Relating to others (7 items), New Possibilities (5 items), Personal strength (4 items), Spiritual change (2 items), and Appreciation of life (3 items). The total score may also be used, as in this study
PTSS-10	Post-traumatic stress scale of 10 items; two versions exist, one with 10 items and one with 12. Each item may be scored dichotomously, 0 – No or 1 – Yes, or as a continuous measure with scoring options from 1 to 7. The sum score of all items is used for analyses
PTSS-12	Post-traumatic stress scale with 12 items. This is the same instrument as above, though two more items have been added at the end. It is scored as described above
PTSS-12 I8W	Post-traumatic stress scale for the initial 8 weeks (=I8W). PTSS is used retrospectively to capture the duration of the survivor responses in the initial 8 weeks after the event. See appendix for a specimen
SCID I	Structured Clinical Interview for DSM Disorders. This is a structured diagnostic interview that gives the DSM-IV diagnoses at the time of the interview but also lifetime diagnoses. To explore additional aspects of PTSD, some modifications were added to the PTSD part of the interview

Development in Mental Health

Through several approaches, the survivors were investigated with regard to possible changes in mental health over the decades. Three mental health parameters were used: symptom severity by using the PTSS and the number of cases as identified by screening by using GHQ at each wave of data collection and also by the SCID I current and lifetime diagnoses in 2007.

Symptom Severity and Caseness 1980–2007

Symptom severity is the sum score or the mean score of standardized symptom measures such as the GHQ – the General Health Questionnaire, PTSS – Post-traumatic

stress scale, etc. With a few exceptions, the scales in this study could be administered both to survivors and to members of the comparison group; the completion was not dependent upon exposure to a major stressor. Screening for potential cases of psycho-pathology was made by using the recommended threshold or cutoff point for that particular scale.

Within the survivor group, the level of symptom severity according to PTSS-12 measured in 1980 was M 4.8 (SD 2.7) and in 1981 M 2.9 (SD 2.5). Caseness according to GHQ was found in 36 % in 1980 and 26 % in 1981. For both symptom severity and caseness, a significant fall was observed within the survivor group during the first year. After that time, both remained fairly stable with no further significant changes between the later measure points.

Comparisons between the survivors and the comparison group were possible in 1985 and 2007. In 1985, the PTSS-12 sum score of the survivors and the comparison group was 3.6 and 1.7 ($p < 0.001$), respectively. In 2007, there was no longer a significant difference between the two groups. However, when comparing the groups with regard to each of the 12 single items of the PTSS-12 in 2007, 2 items showed significant differences; the startle reactions (U = 6.96; $p < 0.05$) and the tendency to withdraw socially (U = 5.02; $p < 0.05$) were higher among the survivors.

When comparing the two groups with regard to the number of cases identified by means of GHQ-20, the between-group difference was significant in 1985 (Survivors 22 % vs. Comparison group 8 %; RR = 2.62; 95 % CI = 1.16–5.89; $p = 0.031$). In 2007, no significant difference was found between the groups in regard to the number of cases.

Within the survivors, significant changes were observed only during the first year post trauma. However, a significant difference between the two groups was found in 1985, but not again in 2007 by using self-rated inventories. There are 22 years between those measure points. A relevant question would therefore be when within that timeframe did the difference lose its significance? The information on health insurance data can provide us with an answer to the question.

Diagnostic Groups, PTSD, and Subsyndromal PTSD

Early in 1980s, no suitable structured diagnostic interviews were available. In 2007, the SCID I interview was conducted, usually over the phone, and involved every willing and able participant, survivor and comparison group member alike. SCID-I is based on the DSM-IV criteria. It is a structured diagnostic interview. The interviews were taped and scored by a second rater. Excellent inter-rater agreement was achieved. The diagnoses were scored at the time of the interview; lifetime diagnoses were scored at the same time. Due to the low number of participants, the diagnoses (with the exception of PTSD and subsyndromal PTSD) were categorized into four groups: anxiety disorders, depressive disorders, somatoform disorders, and disorders related to substance abuse.

In 2007, the risk of having any psychiatric diagnosis in 2007 was more than three times higher for the survivors than for those not exposed to the oil rig disaster

(RR = 3.44; 95 % CI 1.56–7.60; p = 0.003). When looking at the various diagnostic groups in more detail, the biggest difference between the survivors and the comparison group was found for the anxiety disorders (RR = 4.52; 95 % CI = 1.14–17.94; p = 0.040), when excluding PTSD and subsyndromal PTSD. For the depressive disorders, there was also a significant difference (RR = 2.236; 95 % CI = 0.72–7.06; p = 0.205). The 2007 differences with regard to misuse and somatoform disorders were not significant at the time. The structured interviews brought out some differences in 2007, while the self-rated inventories did not.

Lifetime Psychopathology

About 50 % of the survivors had some kind of psychiatric disorder at some point after the disaster, while 23 % in the comparison group had (RR = 2.21; 95 % CI = 1.31–3.73; p = 0.004). When breaking this down into diagnostic groups, lifetime depression disorders were found in 35 % of the survivors and in 18 % in the comparison group (RR = 2.00; 95 % CI = 1.05–3.80; p = 0.047). For the anxiety disorders excluding PTSD and subsyndromal PTSD, the numbers were respectively 21 % and 5 % (RR = 4.31; 95 % CI = 1.41–13.14; p = 0.015). Lifetime somatoform disorders were only found among the survivors, 10.4 %. Lifetime substance misuse was diagnosed in 21 % of survivors and in 10 % in the comparison group (RR = 2.58; 95 % CI = 0.98–6.78; p = 0.09). Three subjects reported psychiatric diagnoses before the disaster.

PTSD Manifestations

Some researchers have argued that the C criteria of PTSD in DSM-IV are too strict; unfairly, the criteria prevent some eligible patients from receiving the treatment and support that they deserve. Accordingly, criteria for a subsyndromal PTSD have been suggested (Stein et al. 1997; Norris and Slone 2007). Subsyndromal PTSD is scored whenever a survivor met at least one of the C criteria, in addition to having fulfilled the A and B criteria. In our study, both the PTSD and the subsyndromal PTSD were rated. Some additions related to PTSD were also made to the SCID to allow further exploration of aspects of reactivated and delayed PTSD, as well as the role of residual PTSD symptoms in relation to reactivation.

In the lifetime section of the SCID I interview, the incidence of an early-onset PTSD among the survivors was 23 % and in addition comes 15 % having subsyndromal PTSD. After 27 years, concurrent full PTSD was found in 6 % in the survivor group and 2 % (one person) in the comparison group; this did not give a significant difference. However, when using the subsyndromal criteria, a significant difference emerged. From the time of the disaster until the last follow-up study, 27 % met the diagnostic criteria of PTSD at some point.

Comorbidity Issues

All survivors with PTSD or with subsyndromal PTSD in 2007 had a history of depression, 80 % of whom had chronic depression, either recurrent depressions or dysthymia; 60 % had a history of substance misuse; and 50 % had a history of another anxiety disorder. Today, it is well known that PTSD appears with a high degree of comorbidity (Brady et al. 2000). Also, in this study, the survivors were more likely to receive multiple diagnoses; 10 % had two diagnoses versus 7 % in the comparison group, and 25 % had three or more diagnoses versus 3 % in the comparison group.

In some cases, diagnostic entities other than PTSD may dominate the post-traumatic picture. Moreover, in the long run, intrusion, avoidance, and psychophysiological manifestations, the three typical symptom clusters of PTSD, may be replaced by other, more regular psychiatric entities such as depression and anxiety. It seems that post-traumatic stress serves as a transitional psychopathology for some. In 2007, the presence of PTSD or subsyndromal PTSD was much lower than earlier on. Based on these observations, it seems that in the very long-term perspective, psychopathology is likely to manifest eventually as depressions or anxiety disorders, rather than as PTSD. For more details about the various prevalence data above based on SCID I, see Boe et al. (2011).

Reactivation

In combat veterans, reactivation of PTSD has been reported (Solomon and Mikulincer 2006), while for civilian disasters such reports are rare. Reactivation implies that a person had an episode of PTSD, recovered, and later on had another PTSD episode. In this study, at least 6 months of normal, regular functioning should have passed before a new episode would be rated. Delayed PTSD was rated separately, provided there was no identified early onset of PTSD.

Clinically, the idea of reactivated post-traumatic stress seems rather well accepted, but the diagnostic systems have given the matter little attention. From a research point of view, there are several unresolved issues related to reactivated PTSD (Holen 2007). It may be hard to determine if a second or later episode of PTSD is a response to a trigger, i.e., a low-grade stressor; a new episode precipitated by a major stressor; a reactivated response; or a delayed response.

If a survivor reported that he had experienced any additional major stressors after the oil rig disaster, the most severe episode was assessed in more detail with regard to reactivation. About two-thirds of the survivors were resilient, with no reports of PTSD at any point in the aftermath of the disaster. Using the subsyndromal criteria, reactivated PTSD was noted in about 20 % of the survivors, of which 4 % were classified as having a possible delayed onset, i.e., without clear prior manifestation of PTSD (Boe et al. 2010).

Residual Symptoms and Reactivation

The role of residual PTSD symptoms between the episodes was of interest. To explore the matter, the items from the Impact of Event Scale (IES) were recorded into a dichotomized form. Residual PTSD symptoms were rated as not being present if an IES item was rated 0. However, for any other endorsed value from 1 to 5, residual symptoms were considered to be present, and the item was scored 1. Thus, the number of positive endorsements was summed up as an approximation of the amount of residual symptoms. The IES was given to the survivors at every wave of data collection. Accordingly, the status of the residual symptoms was computed at all four data collection points as the total sum of the Intrusion items and the total sum of the Avoidance items, with a potential scoring range from 0 to 7 or from 0 to 8, respectively. Chronic cases were excluded from these analyses as they would not display possible reactivation phenomena.

By using the residual symptom scores, no significant prediction was reached by using the data from 1980. However, after 14 months, i.e., in 1981, in the second wave of data collection residual symptom levels of intrusion and avoidance predicted significantly the subsequent reactivations. In more detail, those survivors who reported sleep-related intrusions or who stayed away from reminders, or both, were more likely to show reactivation (Boe et al. 2010).

After 5 years, in 1985, five of seven intrusion items had the ability to predict reactivation. Intrusions in general and sleep-related intrusions in particular were consistently the clearest predictors of reactivated or delayed PTSD. With regard to avoidance items, both a person reporting awareness of unresolved issues from the traumatic event and someone who acknowledged that he did not deal with pressing post-traumatic issues predicted reactivated PTSD. For more details on reactivation, see Boe et al. (2010).

Health Insurance: Sick Leave and Disability

In this part of the study, we looked at the annual degree of functional impairment, defined as the number of weeks per year in which a participant was either on sick leave or on disability pension irrespective of diagnosis. A publication in 1991 showed no significant difference in the number of weeks on sick leave or disability in the 2 years prior to the disaster between the survivors and the comparison group, indicating that the matching was successful and that the groups could be regarded as comparable. However, within the following 8 years *after* the disaster, significant differences were demonstrated annually (Holen 1991), which is a clear indication that the disaster was the precipitating event for their increased absence from work due to health problems. A later follow-up study on this data looked at functional impairment for all 27 years (Holgersen et al. 2016). One central research question was whether this difference each year would forever remain between the two groups or gradually increase or dwindle.

The finding was that during the initial 12 years post disaster, the survivors persistently showed higher rates of annual functional impairment than the comparison group. After those 12 years, the survivors still had higher rates, but the differences were no longer significant within each single year (Holgersen et al. 2016).

In more detail, the subgroup analyses by means of growth mixture modeling (Muthèn 2001; Muthèn and Muthèn 2007) identified two distinct groups. The first was a minor group (N = 9) with very high levels of functional impairment. The other group could be on sick leave from time to time but mostly remained healthy. In the minor group, 89 % (8/9) came from the survivor group, while 11 % (1/9) came from the comparison group.

Those who in 1980 reported high levels of experienced peritraumatic death threat during the disaster had significantly higher degrees of functional impairment. Likewise, a measure in 1985 on social withdrawal was also significantly correlated with higher functional impairment (Holgersen et al. 2016).

Early Prediction of Long-Term Outcome

Before we go into more detail about the early prediction of a later outcome, we need to take a brief look at the Post-Traumatic Stress Scale (PTSS) and its particular use in this part of the study.

Post-Traumatic Stress Scale

The Post-Traumatic Stress Scale (PTSS) (Holen 1990) exists in two versions. Historically, the first version had 10 items, and the later one had 12 items. In addition, two different ways of scoring the items are in use: they may be scored in a dichotomous manner with the response options 0 – No and 1 – Yes or with a continuous scoring from 1 to 7 (Weisæth and Mehlum 1993). The PTSS score is the sum of all positive endorsements both in the 10-item and in the 12-item version. The evaluation of the PTSS scale has shown good psychometric properties (Eid et al. 1999). For the early prediction of a later outcome, only the dichotomous 10-item version was used. In 1980, reconstructions of six initial time points were made to cover the development in the immediate aftermath of the disaster by the items from PTSS-10. The reconstructed measure points covered the first 1–3 days, 4–7 days, 2nd week, 3rd week, 4th week, and 5th–8th weeks or longer immediately after the disaster. In this manner, six sum scores were obtained. The sum scores were used to compute each survivor's recovery slope. For this disaster, the computations showed that only the first 3 weeks were required to make good long-term predictions of the mental health outcome. Two aspects of the recovery curves indicated possible links between the very early response pattern in terms of the slope of the survivor and the very long-term outcome with regard to psychopathology. A specimen of the inventory in English with 12 items has been included in the Appendix (PTSS-12

I8W); the calculated sums at the very bottom of each column provide the numbers from which the recovery slope can be estimated for each survivor (Table 1).

Early Response and Future Outcome

The levels of long-term psychopathology were assessed using GHQ-20 as a screening tool in 1980, 1981, 1985, and 2007. The two measures, the initial PTSS-10 I8W recovery slopes and the subsequent GHQ-20 screening status of each survivor, were combined to look for latent classes of the participants by using growth mixture modeling (Muthèn 2001; Muthèn and Muthèn 2007). The survivor's GHQ-20 scores in 1985 and 2007 were also contrasted with the comparison group. Four latent classes of survivors emerged: the resilient group (61 %) with a rapid recovery, those with a slow recovery (14 %), those relapsing (13 %), and the chronic ones (11 %) (Holgersen et al. 2011). The four classes found in this study were in line with the theoretical concepts of adaptation to trauma suggested by others (Bonanno 2004).

When assessing the characteristics of the initial recovery slope of these four classes of survivors, two aspects are of special interest, the starting point of the slope – high, medium, or low – and the decline of the recovery slope. The changes over the 8 initial weeks were collected, but in this case, computations within the initial 3 weeks proved to be enough for good predictions.

The resilient ones were characterized by low initial levels of the PTSS-10 scores at the start, and their slopes demonstrated a rapid decline. In the long run, the resilient reported no or very few mental problems over the 27 years. Those with the slow recovery, those with the relapses, and those with the chronic problems all had initially high PTSS scores in contrast to the resilient (Holgersen et al. 2011).

Post-Traumatic Growth

Post-traumatic growth (PTG) is a self-reported entity, and it is founded on the idea that struggling with highly stressful events may sooner or later lead to positive personal and psychological changes (Zoellner and Maercker 2006). What self-reports about post-traumatic growth really imply is still subject to debate (Nolen-Hoeksema and Davis 2004), and the measures of such growth may not have reached a unified and satisfactory level of conceptualization and measurement. Some have suggested that different researchers in the field have been studying rather diverse PTG concepts (Helgeson et al. 2006).

Accordingly, findings about post-traumatic growth (PTG) have not been consistent in the research literature. The original authors argued that the level of post-traumatic stress must have reached some intensity in order to instigate PTG. Furthermore, they held that PTG is not identical to increased well-being or decreased distress. Rather, it is associated with richer and fuller lives (Tedeschi and Calhoun 2004). Several critics have opposed their views. The Janus-faced model (Maercker

Table 1 Post-traumatic stress scale – 12 items. By summing up the positive endorsements at the bottom, a retrospective display is obtained of the changes in the post-traumatic stress levels in the initial phase. This may be helpful in assessing the prospects of the informant

PTSS–12 I8W Post-Traumatic Stress Scale
– How did you feel the first days and weeks immediately after the event? Please indicate below.

ID# |___|___|___|

Instruction: Below are 12 statements about various problems people may have for a shorter or longer time after having experienced a major stressful event. Read each statement and indicate for how long the problem bothered you, if at all. If you already had this problem before the major event, only indicate if it got worse after the event. In that case, your response should reflect the length of the worsening. Please indicate your response by inserting either **an X or a line** below:

- *a **horizontal line** – shows duration. You draw a shorter or longer line* to indicate how long the problem bothered you in relation to the time options given at the top of the columns: first 1-3 days, 4-7 days, 2nd week, 3rd week, 4th week or 5th-8th week or longer
- insert an **X** in the first column if the problem of the statement never bothered you at any time after the event, but also if it did not get any worse in case you already had that problem before.

Normally, you start drawing the horizontal line from the column that covers the first 1-3 days and let the line go as far to the right as necessary to show how long you felt bothered. No endorsement is right or wrong. The important thing is that you indicate for each of the 12 statements what bothered you and for how long. The line may be short or long depending on how long you felt the problem. Please, do not skip any statement.

Please enter either an X or draw a line after each statement:	Not at any time (X)	First 1-3 days	Next 4-7 days	2nd week	3rd week	4th week	5th–8th week or longer
01. difficulties with sleep							
02. nightmares or unpleasant dreams about the event							
03. depressed mood							
04. tendency to jump or startle at sudden noises or moves							
05. tendency to withdraw from contact with others							
06. irritable feelings (I am easily getting irritable or angry)							
07. unstable mood; frequent ups and downs							
08. bad conscience, self-accusations or guilt							
09. fear of situations that may initiate memories of the event							
10. tension in the body							
11. poor memory							
12. difficulties in concentrating							

Please do not write in the box below:

Sum scores per column of PTSS-12 IW							

and Zoellner 2004) suggested that one aspect of the post-traumatic response is in line with the original theory and represents positive changes. However, PTG also involves a dysfunctional aspect of distorted and/or illusory perceptions used by individuals to counterbalance their emotional distress. Furthermore, critical questions have been raised about when, in the wake of an adverse event, mental health problems would dominate and when it is likely that the fuller and richer life will manifest.

In the Kielland study, some of these problems could be addressed, because past levels of post-traumatic stress had been measured. From the scores on the Impact of Event Scale at the various data collection points, we could explore whether high levels of past post-traumatic stress would correlate with the degree of subsequent reported post-traumatic growth.

At the 27-year follow-up, the Post-traumatic Growth Inventory (PTGI) (Tedeschi and Calhoun 1996; Calhoun and Tedeschi 2006) was completed by 46 survivors. This inventory is probably the most frequently used in relation to post-traumatic growth studies. It is a self-report instrument with 21 items covering 5 subscales: Relating to others (7 items), New possibilities (5 items), Personal strength (4 items), Spiritual change (2 items), and Appreciation of life (3 items). The total sum score is also used, as in this study. Each item is rated on a Likert scale; the response options went from 0 – "I did not experience this change as a result of my crisis" to 5 – "I experienced this change to a very great degree as a result of my crisis."

The survivors' total PTGI score as the dependent variable was tested in a multiple regression analysis against the total Impact of Event (IES) scores from the four prior measure points of the study. No significant associations were found in relation to any of the past measures of IES. Meanwhile, the IES scores from 2007 remained the only significant predictor (beta = 0.45, $p < 0.05$) of the reported PTG in 2007. Thus, post-traumatic growth decades after the trauma was associated with the concurrent mental suffering, i.e., at the time of the study in 2007, and not as a result of higher post-traumatic manifestations and struggles in the past (Holgersen et al. 2010). With these findings in hand, the post-traumatic growth captured by PTGI in our study seemed to represent a way of coping with the burden, a way of finding comfort by attributing something good to the adverse event of the past as suggested by some researchers (Wortman 2004). It did not emerge as a reasonable interpretation to suggest that the levels of reported post-traumatic growth were the results of past struggles with high levels of mental crisis or problems.

Key Facts

- **The North Sea oil rig disaster:** This is also referred to as the Alexander L. Kielland disaster, or simply as the Kielland disaster. It happened on 27 March 1980. One of five legs broke off from a floating rig during stormy weather conditions. The rig tilted and after little more than half an hour capsized completely upside down. On board were 212 men, 123 of whom died and 89 of whom survived; 75 of them had their domicile in Norway, and they were included

in a long-term disaster study on post-traumatic stress. At the time, this was the biggest oil rig disaster offshore in terms of lives lost.

- **Measures of mental health:** symptom severity, screening of cases, and SCID I diagnoses. Symptom severity is measured by standardized questionnaires as the sum score or the mean score of how informants endorsed the items. On a continuous scale, symptom severity provides an indication of how much a person is suffering. Cases or caseness is a categorical estimate that indicates who in a group is likely to have a psychiatric diagnosis. Screening for cases is not meant to be an exact measure of mental disorders, but it gives a rough estimate or an approximation. Screening is the process that leads to a decision about caseness. Screening for caseness can be done by some of the standardized symptom measures for which a threshold or a cutoff point has been calculated. Informants with scores above the cutoff point are assumed to be cases. The words "case" and "caseness" are used interchangeably. A case identified by screening is considered to be an approximation, while a psychiatric diagnosis is a definite assessment of the mental disorder being present.

- **Health insurance data in Norway**. As part of the welfare state, it is obligatory for every person living or working in the country to be enrolled in the governmental Norwegian Health Scheme. All utilization of health services as an inpatient or outpatient is registered in the NHS right from the start. A person, who is employed, gets full payment from his employer from the 1st day of sick leave until the 16th day. Thereafter, the Norwegian Health Scheme takes over. Only sick leaves longer that 16 days are registered at the health insurance authorities; only these are a part of this study. Around the millennium, there was a restructuring in Norway of the public registration system from manual to digital registration and at the same time a change from local to centralized registration on national levels.

Summary Points

- Within the survivors, a significant fall in symptom severity and in the number of screened cases was observed during the first year after the disaster. Thereafter, the situation seemed to stabilize when using self-rated inventories.
- Subgroup analysis identified four long-term trajectories of survivors: the resilient (61 %) recovering very quickly; those recovering slowly (14 %); those relapsing one or more times in the aftermath (13 %); and the chronic ones (11 %) being troubled right from the disaster and ever after.
- Two characteristics predicted the long-term outcome within the very first 3 weeks post disaster: (1) the starting level of the PTSS scores and (2) the decline of the recovery slope.
- Over the 27 years, the number of PTSD cases dwindled, while manifestations of anxiety and depression occupied a bigger part of the symptomatology, an observation in support of seeing post-traumatic symptomatology as a transitional pathology in some cases.

- As indicated by the SCID I, the survivors had more than three times higher risk of being diagnosed with psychiatric disorders than those in the comparison group; the biggest difference was found for the anxiety disorders, and the difference for depressive disorders was also significant.
- The most prevalent lifetime psychiatric diagnoses were the depressive disorders; 35 % of the survivors had one or more depressive episodes, as opposed to 18 % in the comparison group. Lifetime somatoform disorders (10 %) were only found in the survivor group. As for lifetime substance misuse, 21 % in the survivor group versus 5 % in the comparison group were detected.
- Some 23 % among the survivors had early-onset PTSD, and when the subsyndromal criteria were taken into consideration, the number of cases increased by 15 %. After 27 years, the number of full PTSD was down to 6 % among survivors, while only 2 % (one person) in the comparison group experienced full PTSD.
- Occurrence of comorbidity in the survivors exceeded by far that of the comparison group.
- Residual PTSD symptoms predicted reactivation of PTSD.
- Based on national health insurance data, the annual difference in the number of weeks on sick leave or disability between survivors and members of the comparison group was seen for the first 12 years post disaster. Thereafter, the annual number of weeks of functional impairment was still higher for the survivors, but the difference no longer reached significance within each year.
- Post-traumatic growth in 2007 was significantly predicted by the concurrent mental health problems and not by the survivors' severity of post-traumatic symptoms in the past.

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