Psychological Outcome, Fatigue, and Quality of Life After Infection With Shiga Toxin–Producing *Escherichia coli* O104

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BACKGROUND & AIMS: **From May through July 2011 in northern Germany, there was a large outbreak of hemolytic uremic syndrome and bloody diarrhea, which was related to infections from Shiga toxin–producing *Escherichia coli* O104 (STEC). We investigated the depression, posttraumatic symptoms, fatigue, and health-related quality of life among patients within the first 6 months after STEC infection and aimed to identify factors associated with poor outcome.**

METHODS: **In a cohort study, we performed baseline assessments of 389 patients (69% female) 3 months after STEC infection (82 ± 36 days) and follow-up assessments of 308 of the patients 6 months afterward (199 ± 17 days). Data were collected at 13 hospitals in northern Germany. Patients completed validated self-report scales and a diagnostic interview.**

RESULTS: **At baseline, hemolytic uremic syndrome was diagnosed in 31% of the patients. Six months after the infection, mean self-reported severity of depression and posttraumatic symptoms and fatigue were significantly greater than in the general population, and the mean score from the mental component of health-related quality of life survey was significantly lower than average. Posttraumatic stress disorder had recently developed in 3% of patients (95% confidence interval, 1%–5%), and 43% of patients had clinically relevant fatigue (95% confidence interval, 41%–45%). The most important baseline factors associated with poor psychological health 6 months after STEC infection were previous traumatic events, neuroticism, and low social support (all $P < .05$).**

CONCLUSIONS: **Six months after the major outbreak of STEC infection in northern Germany, a substantial number of patients had poor psychological health, persistent fatigue, and impaired quality of life. For future outbreaks, patients' premorbid risk factors should be considered, which might minimize the long-term effects of infections on mental health.**

Keywords: Posttraumatic Stress Disorder; PTSD; Chronic Fatigue Syndrome; Mental Disorders; HrQoL.

Between May and July 2011, northern Germany experienced the largest outbreak of hemolytic uremic syndrome (HUS) and bloody diarrhea related to infections from Shiga toxin–producing *Escherichia coli* O104 (STEC) to date. Within 4 weeks, a total of 3842 outbreak cases were registered, 2987 patients (77.7%) experienced acute gastroenteritis, and 855 cases (22.3%) developed into HUS. Fifty-three patients (1.3%) died of the infection.[1,2] Infected sprouts were finally identified as the cause of the outbreak. The brunt of disease is systemic, acting via toxin binding to the glomerular endothelium, whereas the gastroenterological damage is more transitory. Although the somatic outcomes of this STEC outbreak are extensively being studied,[1] the psychological consequences have thus far been neglected.

The experience of STEC/HUS-related symptoms combined with the experience of neurological dysfunction, fear of death, and sudden dependence on help may be considered as severe psychological distress or a traumatic

Abbreviations used in this paper: **CI, confidence interval; DSM-IV, Diagnostic and Statistical Manual [of Mental Disorders], Fourth Revision; ES, effect size; FS, Fatigue Scale; GAD-7, Generalized Anxiety Disorder Scale; HrQoL, health-related quality of life; HUS, hemolytic uremic syndrome; MDD, major depressive disorder; PDS, Posttraumatic Stress Diagnostic Scale; PHQ, Patient Health Questionnaire; PTSD, posttraumatic stress disorder; SCID, Structured Clinical Interview for DSM-IV; SF-12, 12-Item Short Form Health Survey; STEC, Shiga toxin–producing *Escherichia coli* O104.**

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event. After the treatment of other diseases in intensive care units, elevated rates of depressive disorders, anxiety disorders, and posttraumatic stress disorder (PTSD) have been observed.[3,4] Characteristics that predicted the development of PTSD included factors such as female gender, younger age, low educational level, preexisting psychiatric disorder, prior traumatic events, high severity of trauma, and low social support.[5] Previous studies have also demonstrated the association between PTSD and depression, anxiety, and functional impairment.[6]

Chronic fatigue is also often preceded by infectious diseases such as *Giardia* duodenalis, *Campylobacter* gastroenteritis, and infections from the Epstein–Barr virus.[7,8] However, there has been no consistent evidence to date suggesting that chronic fatigue results from a specific infection; rather, a diverse group of infections may trigger or perpetuate the symptoms of chronic fatigue.[7] In addition, anxiety and depression have been identified as strong predictors of chronic fatigue in many studies.[7] Altogether, chronic fatigue appears to be a heterogeneous condition, and its multifactorial etiology requires further research. So far, no study has investigated the role of STEC infection regarding the onset of persisting fatigue.

Because future outbreaks of STEC (or related pathologic bacteria) are possible, it is important to investigate the psychological repercussions and their predictors to enable early detection and treatment. Our aim in the current study was to prospectively follow patients soon after their STEC infection and track changes in psychological health and quality of life over time. Specifically, we aimed to describe the course of depression, anxiety, posttraumatic stress symptom severity, fatigue, somatic symptoms, and quality of life 3 months and 6 months after the infection. The second aim was to identify predictors of these outcomes to help identify patients at higher risk of experiencing extreme psychological reactions to such diseases. For this purpose, we developed a hypothetical model regarding potential predictors of the development of PTSD and other indicators of poor psychological health 6 months after STEC infection (Figure 1). Because of the high association between PTSD and other psychological and somatic symptoms,[6] we used the same hypothetical model for all outcome variables. This model was then tested for the prediction of depression, anxiety, posttraumatic stress, symptom severity, fatigue, somatic symptoms, and quality of life 6 months after infection.

Methods

Patient Sample

We conducted a prospective cohort study in patients with bloody diarrhea and/or HUS caused by STEC. Baseline assessment was performed within the first 3 months (T0), and the follow-up assessment (T1) was conducted 6 months after STEC infection. Inclusion criteria were clinical diagnosis of STEC/HUS disease, stable medical status, sufficient knowledge of the German language, and informed consent. We collected data from 13 hospitals in northern Germany. For the baseline assessment, patients who visited the specialized STEC outpatient clinic of the participating medical university hospital were recruited in the hospital waiting room (26% of total sample). All other patients received a letter explaining the study, the informed consent form, and the study questionnaire by mail from their treating hospital. Patients who did not respond within 3 weeks were telephoned and requested to participate in our study. Patients who did not participate in the follow-up assessment received one reminder. The research protocol for this study was approved by the ethics committee of the local medical association, and all participants gave written informed consent.

Measures

At baseline, demographic characteristics, current illness symptoms, preexisting conditions including irritable bowel syndrome and fibromyalgia, history of

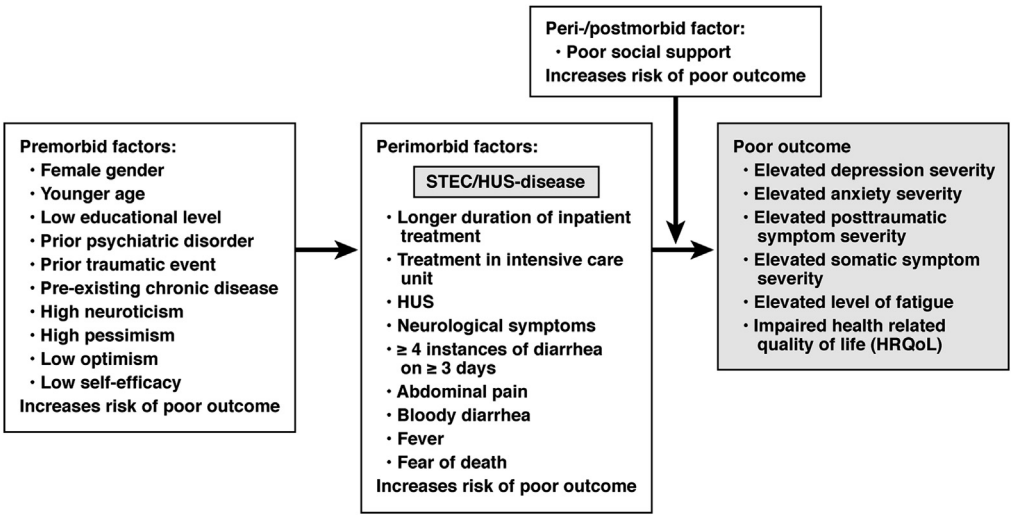

Figure 1. Hypothetical model regarding the potential predictors of poor psychological health 6 months after STEC infection. The figure illustrates the potential influence of premorbid, perimorbid, and postmorbid factors on psychological health.