

Psychosocial Impact of Fracking: a Review of the Literature on the Mental Health Consequences of Hydraulic Fracturing

Jameson K. Hirsch¹ · K. Bryant Smalley² ·
Emily M. Selby-Nelson³ · Jane M. Hamel-Lambert⁴ ·
Michael R. Rosmann⁵ · Tammy A. Barnes⁶ ·
Daniel Abrahamson⁶ · Scott S. Meit⁷ · Iva GreyWolf⁸ ·
Sarah Beckmann⁹ · Teresa LaFromboise¹⁰

Published online: 31 July 2017

© Springer Science+Business Media, LLC 2017

Abstract The process of natural gas extraction known as hydraulic fracturing, or fracking, is a controversial energy acquisition technique often viewed with disdain by the public, due to its potential for environmental harm. However, the mental health and psychological well-being of fracking communities, including potential benefits and detriments, are often overlooked. We reviewed the literature on the association between fracking and psychological functioning, finding that although persons living in fracking communities may experience some minimal, initial benefits such as land lease income or infrastructure development, they may also

✉ Jameson K. Hirsch
hirsch@etsu.edu

¹ Department of Psychology, East Tennessee State University, 420 Rogers Stout Hall, Johnson City, TN 37614, USA

² Department of Psychology, Georgia Southern University, Statesboro, GA, USA

³ Cabin Creek Health Systems, Charleston, SC, USA

⁴ Department of Pediatrics, Nationwide Children's Hospital, Ohio State University, Columbus, OH, USA

⁵ Department of Occupational and Environmental Health, University of Iowa, Iowa City, IA, USA

⁶ American Psychological Association, Washington, DC, USA

⁷ Central Arkansas Veterans Health System, Little Rock, AR, USA

⁸ The Society of Indian Psychologists, Albany, NY, USA

⁹ Yakima Valley Farm Workers Clinic, Toppenish, WA, USA

¹⁰ Department of Developmental and Psychological Sciences, Stanford University, Stanford, CA, USA

experience worry, anxiety, and depression about lifestyle, health, safety, and financial security, as well as exposure to neurotoxins and changes to the physical landscape. Indeed, entire communities can experience collective trauma as a result of the “boom/bust” cycle that often occurs when industries impinge on community life. Impacted communities are often already vulnerable, including poor, rural, or indigenous persons, who may continue to experience the deleterious effects of fracking for generations. An influx of workers to fracking communities often stokes fears about outsiders and crime; yet, it must be recognized that this population of mobile workers is also vulnerable, often ostracized, and without social support. Practitioners, researchers, and policy makers alike should continue to investigate the potential psychological ramifications of fracking, so that effective and targeted intervention strategies can be developed, disseminated, and implemented to improve mental health in fracking communities.

Keywords Fracking · Hydraulic fracturing · Mental health · Quality of life · Stress · Rural

The extraction of shale gas by unconventional means (i.e., unconventional gas extraction), known as hydraulic fracturing (fracking), is a drilling strategy that aims to release trapped natural gas. This process is conducted by creating fissures in the ground (often via horizontal drilling that impacts land adjacent to gas fields) or by using existing wells and injecting hydraulic fracturing fluid, which is a toxic mixture of water, sand, and chemical additives, to force natural gas to the surface. Areas targeted for fracking are often situated in rural locales (Castelli 2015). Rural communities that host fracking operations often experience a “boom/bust cycle,” whereby their population surges, consequently exerting stress on community infrastructure and service provision capabilities (e.g., medical care, law enforcement) (McDermott-Levy et al. 2013; Ruddell et al. 2014). Although there may be some initial benefits to fracking for a community or some individuals within a community (e.g., job availability, royalty checks), there is generally a strong opposition, preceding and during fracking operations, in affected areas (Szolucha 2016). Further, in general, fracking appears to have a poor reputation globally and is increasingly recognized as a contributor to environmental health problems (Crowe et al. 2015; McCoy and Saunders 2016).

Such types of deleterious community outcomes are well-documented in the extant literature; however, what are often overlooked are the mental health and psychological well-being of fracking communities, at both the individual and group level (Illes et al. 2014). Preliminary evidence suggests that persons living in communities impacted by fracking experience worry and anxiety about themselves and their communities (Brasier et al. 2014), including about the degradation of their lifestyle, safety, and financial security. Furthermore, due to the ramifications of the boom/bust cycle, communities themselves can be traumatized by the entrance of the fracking gas industry into their lives (Perry 2012). With the production of shale gas growing rapidly in the USA and globally (e.g., it is projected that shale gas will account for 55% of natural gas production by 2040), it is critical that researchers and clinicians address the potential psychological ramifications of fracking (Clough and Bell 2016); such insight will help to inform the inoculation of communities prior to fracking, as well as intervention efforts during and after fracking, given the risk that this industry sometimes poses for communities. As such, in the current manuscript, we review the existing interdisciplinary literature that either qualitatively or quantitatively, and either empirically or theoretically, addresses the interpersonal and psychological consequences that shale gas and oil extraction have on a community and its citizens.

Search Strategy for Identification of Studies

We conducted a comprehensive review of the literature, using a framework inspired by the PRISMA strategy (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Liberati et al. 2009), focused on the impact of fracking on psychological and behavioral health, and all identified studies were included regardless of study design or methodology. All studies focused on fracking or other forms of forced gas/oil extraction as they related to mental health, interpersonal health, psychological well-being, and community health were eligible for inclusion. An electronic search for eligible studies was conducted using the following electronic databases: MEDLINE (1966–2016) and PsycInfo (1966–2016); Google Scholar was also used as a resource for identifying white papers, theses and dissertations, and governmental and other reports. Although fracking did not emerge as an energy extraction technique until after the turn of the twenty-first century, we used an earlier date search parameter, so that we might also place fracking into the larger, more evolved literature on boomtowns that existed prior to the year 2000. Search strategies were developed using combinations of the following keywords/index terms: fracking, hydraulic fracturing, mental health, psychopathology, depression, anxiety, substance abuse, public health, and community health. There was no language restriction. Retrievals were reviewed by title and abstract to identify studies appearing to qualify for the review, and the final decision for inclusion was based on the full report. Although this literature review is exhaustive, we do not report every citation or resource, so as to avoid duplication of content and, rather, we summarize emergent themes in the study of psychological issues occurring as a result of fracking (see Table 1); snowballing and saturation techniques were applied in the development of thematic coding and citation selection.

Review of Literature on Psychosocial Consequences of Fracking

Individual-Level Impact of Fracking on Mental Health Although rigorous research is lacking, preliminary evidence suggests that fracking can exert a negative influence on the well-being and quality of life of those affected. However, it must be noted that these deleterious relations may be dependent on one's perception. In a recent study, Lai and colleagues found that, if a person's perceptions of fracking were positive (e.g., fracking will have a beneficial impact on the self and community), they were more likely to experience positive emotions and well-being, compared to those who perceived fracking as harmful (e.g., anticipated loss of personal or community resources), who experienced negative emotions and poorer well-being (Lai et al. 2017).

With regard to potential poor health outcomes, however, it is becoming increasingly well-established that individuals in fracking communities experience a wide range of illnesses (e.g., increased rates of cancer) and physical symptoms, including fatigue, headaches, ocular and dermatologic irritation, confusion, and delirium, as well as an array of additional respiratory, gastrointestinal, immunological, endocrine, and sensory maladies (McDermott-Levy et al. 2013; Bamberger and Oswald 2012; Balise et al. 2016). Additionally, many mobile gas/oil workers, as well as residents of affected communities, develop neurological and neuropsychological symptoms as a result of exposure to toxic chemicals and contaminated water. These symptoms can include problems with balance, disorientation and fainting, and cognitive deficits, developmental delays, and neural tube defects in infants (Cabrera et al. 2016; Tucker 2012; Colborn et al. 2014; McKenzie et al. 2012). Of note, the experience of having

Table 1 Summary of empirically supported literature review findings on fracking and psychosocial health

Author(s)	Publication year	Sample type	Methodology	Main finding
Brasier et al.	2014	Students, low-income residents, institutions, agricultural and healthcare representatives	Policy review, focus groups, and survey	Worry and anxiety about self and community
Drummond and Grubert	2017	Community members	Interview	Tension, loss of trust in the government and industry
Evensen and Steadman	2017	Community members	Interview	Acknowledged potential for flourishing via fracking benefits, with fears of disruption and non-flourishing
Ferrar et al.	2013	Community members	Interview	Stress was the most reported symptom; perceived social and health impacts increased over 2 years
Ferrari	2013	Community members	Interview	Anger, anxiety, loss of power, reduced quality of life
Filteau	2014	Oil/gas workers	Interviews	Perceived stigma and hostility
Jaspal et al.	2014	YouTube contributors	Secondary review of fracking-related YouTube videos	Perceived threat to values, sense of self-efficacy, and community continuity
Lai et al.	2017	Community members	Survey	Negative perceptions of fracking related to negative emotions; positive perceptions related to positive emotions; loss to self and place more salient than gain
Maguire and Winters	2016	Community members	Survey	Poor life satisfaction; more work days missed for mental health reasons
Mauro et al.	2014	Community members, organizations, and industry	Secondary analysis of public comments	Concerns and worries about pollution and traffic and their impact on mental and physical health
McDermott-Levy et al.	2016	Community members	Qualitative and descriptive	Stress, powerlessness
Morgan et al.,	2016	Australian farmers	Survey	Concern about fracking impact to health, farm, and communities; greater depression, anxiety, and stress reactivity
Morrone et al.	2015	Community members	Interviews and survey	Disrupted social cohesion, erosion of community pride, feeling exploited, breakdown of shared community values
Perry	2012	Agricultural landowners	Ethnographic, interviews, and focus groups	Depression, sense of loss, betrayal, guilt, anger, emotional “highs and lows,” long-term health fears for self and children
Perry	2013	Community members	Ethnographic, interviews, and focus groups	Changes in social interactions, altering history and memories, sense of loss and sadness
Powers et al.	2015	Community members	Secondary review of letters to the editor	Concern about changes to rural “way of life,” competition for resources, fear of pollution

Table 1 (continued)

Author(s)	Publication year	Sample type	Methodology	Main finding
Resick et al.	2013	Female community members	Interview	Powerlessness, fatigue, sadness
Saberi et al.	2014	Primary care patients	Survey	Anxiety, sleep disturbances
Sangaramoorthy et al.	2016	Community members	Focus groups	Disrupted sense of place and social identity, changed relationships, social distress including uncertainty, anger, fear, and anxiety
Short and Szolucha	2017	Community members	Ethnographic, interviews, and observation	Stress, worry, collective trauma
Steinzor et al.	2013	Community members	Surveys	Behavioral health, mood, and energy problems
Szolucha	2016	Community members	Ethnographic and interviews	Stress, strain, fear, anxiety, mental anguish, sleep disturbances
Weber et al.	2014	Social service directors	Focus groups	Increased homelessness, domestic violence, and food insecurity

a “mysterious” fracking-induced illness, with a remedy that is, perhaps, perceived to be out of one’s control (e.g., inability to influence removal of, or move away from, toxins), is likely to have adverse effects on mental health, thereby contributing to anxiety and depression. This relationship appears, in many ways, to mirror the well-established interconnections of chronic disease and depression (Chapman et al. 2005).

While evidence continues to emerge regarding direct, individual symptoms associated with fracking, reports of broadly defined social, emotional, and behavioral disturbances are also mounting in fracking-affected communities (Cerros 2015; Ferrar et al. 2013). Many individuals in fracking communities experience exacerbated fears about their health and that of their children, due to the long-term impact of fracking (Perry 2012). Even in the planning stages, prior to resource extraction initiation, involved community members, including both proponents and opponents, report an increased sense of powerlessness, fear, betrayal, guilt, anger, stress, and anxiety, as well as sleep disturbances (Short and Szolucha 2017; Szolucha 2016). Yet, very little empirical research has focused on the psychological and behavioral health of persons and communities impacted by fracking. Furthermore, these topics are typically not addressed in company-level or governmental-level risk assessments of fracking, suggesting an area of critical importance that is overlooked by researchers, clinicians, and policy makers alike (Watterson and Dinan 2015).

Existing research in this domain has been largely qualitative in nature, but clearly appears to focus on central themes of mental distress. For instance, Steinzor and colleagues reported, in a community-based assessment, that fracking is perceived to impact the mood, energy, and behavior of the members of a fracking community (Steinzor et al. 2013). In an interview-based study of community members impacted by the Marcellus shale gas boom, Ferrar and colleagues found that psychological stress was the most frequently reported complaint (Ferrar et al. 2013). In a study of complaints made to the nursing personnel, feelings of stress and powerlessness related to fracking were the most commonly reported consequences (McDermott-Levy and Garcia 2016). In a secondary review of Health Impact Assessments (HIA) of fracking in the UK, Watterson and Dinan found that community members from fracking-affected locales reported fear, anxiety, and stress, as well as sleep disturbances and depression (Watterson and Dinan 2015). Primary care patients interviewed from a Pennsylvania fracking community reported anxiety and sleep disturbances (Saber et al. 2014). In another study, a field survey of female community members in the Marcellus shale region, powerlessness, fatigue, and sadness were attributed to fracking (Resick et al. 2013).

In one of the few empirical studies on this topic, in a sample of Texas residents, horizontal, unconventional gas extraction (as compared to traditional drilling) was related to poorer subjective well-being and more days of work missed due to mental health reasons (Maguire and Winters 2016). Noise pollution from fracking operations (e.g., traffic, flares/burn-offs) is often cited as a source of psychological distress, as well as poor academic performance in children (Redmond and Faulkner 2013). For example, the low-frequency noise that comes from well pumps contributes to irritation, unease, and fatigue (Coram et al. 2014). Light pollution, including, in some areas, constant illumination from fracking operations, can also contribute to stress and sleep disruptions (Korfmacher et al. 2013; Werner et al. 2015). Additionally concerning, and not often considered, is the distress that community members might feel about unknown and dangerous chemicals, soil and water safety, land and housing prices, and job assurances and future livelihoods (Carey 2012; Witter et al. 2010), often manifesting as anger, anxiety, helplessness, and a loss of trust in the industry and the government (Drummond and Grubert 2017; Watterson and Dinan 2015).

Community-Level Impact of Fracking on Psychosocial Functioning Poor mental and physical health outcomes that stem from fracking activities contribute to what is called, from a theoretical perspective, a “negative externality,” or having to bear the cost of the activity of others. In the case of fracking, neighbors and entire communities are often impacted by the actions of others (e.g., outsiders imposing fracking, neighbors engaging in fracking to the detriment of others) (Castelli 2015). At the level of daily engagement, members of fracking communities report experiencing stress from a disrupted social fabric, as their communities experience an influx of non-native workers and businesses, and a disruption to daily routines. Such disruptions contribute to distress for long-time community members, who may view such intrusion with alarm and concern. Indeed, in some communities, residents expressed that they could foresee no positive effects that would emerge from allowing fracking into their community (Szolucha 2016), and these fears are often compounded by perceptions of mistrust and lack of transparency in the actions of the industry and the government (Ferrar et al. 2013). In one past qualitative interview study, this tension is framed in terms of flourishing: on the one hand, residents may perceive the entry of hydraulic fracturing into their community as a means to support, promote, and encourage thriving in a community (e.g., creation of jobs), whereas, on the other hand, they may view fracking as a disruptor to community thriving (e.g., change in way of life) (Evensen and Stedman 2015).

According to the social disruption hypothesis (Jacquet and Kay 2014), the rapid growth and changes that can occur in a fracking community can contribute to an erosion of social norms and can negatively impact and alter collective memories and collective meaning-making for members of a community (England and Albrecht 1984). The long-term impact can be potentially crippling for generations, even after the boom is over (Weber et al. 2014). Social disruption may be particularly problematic for rural areas, where towns are often characterized by long-standing social/political roles and relationships that can be challenged in the face of boomtown development (Jacquet and Kay 2014). As well, indigenous and agricultural communities may be particularly impacted by fracking, given their historical attachment to, and dependency on, the land they live on, which is often damaged as a result of the fracking process (Sangaramoorthy et al. 2016).

In the few studies that exist on this topic, themes of disruption are pervasive, including anger about the outsourcing of natural resources, anxiety about their families and homes, and a negative impact on the quality of life (Ferrari 2013). In a qualitative analysis of “letters to the editor” printed in fracking communities, Powers and colleagues noted that citizens were concerned about the changes to their rural communities, including job availability, threats to water availability and safety, competition for resources with newcomers, and changes to their rural “way of life” (Powers et al. 2015). Additionally, the loss of “peaceful country vistas” has been acknowledged as a potential psychologically damaging effect of fracking for rural areas, as noted in an environmental impact report from Nova Scotia (Mauro et al. 2014). Residents of fracking communities may have to adapt to a change in perception of their hometown from a “farming town” or “peaceful rural area” to a dirty, and even stigmatized, place to live (Jacquet 2014). In another qualitative study, which analyzed perceptions of fracking present in YouTube videos, Jaspal et al. (2014) found that fracking often engenders negative views within communities as an assault on common environmental values (e.g., respecting the “clean air,” idyllic nature, and essence of rural areas) and a threat to both individual-level (e.g., self-efficacy) and community-level continuity (Jaspal et al. 2014). In a sample of 104 fracking-impacted

residents of Appalachia, Morrone et al. (2015) found that the respondents experienced disruptions to social cohesion, erosion to community pride, feelings of being exploited, and a breakdown of shared community values (Morrone et al. 2015).

Industrialization, traffic congestion, and loss of solitude disrupt the rural way of life, as do the sudden appearance and disappearance of workers and their families. This effect can ripple across community institutions such as schools and churches. In most of the communities impacted by fracking, the influx of new residents, as well as the health concerns of current residents, often overwhelms the existing healthcare infrastructure. Fracking-impacted communities often experience increased rates of visits to healthcare professionals and increased rates of hospitalization, emergency room visits, neurological visits, and primary care visits, often taxing already under-resourced local healthcare systems (Brasier et al. 2014; Jemielita et al. 2015).

Gender/sex imbalances are also a frequent source of tension for fracking communities, who may find themselves suddenly overwhelmed with a largely male population, not only creating community tension but also contributing to disruptions in community relationships and fears for the safety of community members (e.g., rates of crime and sexual assault often increase in towns experiencing industrial booms) (Ruddell et al. 2014). Community concerns about “roughnecks” and “man camps,” although often stereotyped, do frequently result in increased rates of violence, sexual assault, sexually transmitted diseases, and the increased presence of illicit drugs (Witter et al. 2008; Tosh and Gislason 2016). The entrance of prostitution and sex trafficking into communities is also often preceded by the appearance of energy resource development industries (Measham et al. 2016). Such threats, whether real or perceived, are not to be underestimated as they injure the collective emotions and well-being of a community. The resulting historical trauma can persist for generations, but is often overlooked as a source of mental and physical distress.

Unfortunately, the burden of resource extraction efforts, such as coal mining, oil drilling, fracking, and other well stimulation techniques, is often disproportionately carried by underprivileged and under-resourced populations, including indigenous, rural, and poor persons, as their living locales often overlap with extraction fields. For instance, Clough and Bell note that fracking is more likely to occur in areas with larger concentrations of poor persons and, further, that those living in the closest proximity to drilling sites were the least likely to reap financial or other benefits from fracking activities (Clough and Bell 2016). Paylor notes that the benefits of fracking are most often manifest for persons in highly or very highly developed regions or countries, whereas the majority of risks of fracking appear to impact persons in areas with low or medium levels of development, such as rural locales (Paylor 2017). Castelli reported that most fracking activities in the USA occur in areas that are rural and poor and that, therefore, these populations experience the most burden from fracking activities (Castelli 2015). As well, the children and the elderly in these locales are often disproportionately impacted by exposure to health hazards (Coram et al. 2014), given their developmental vulnerabilities. Native Americans, particularly those living on rural reservations, may be particularly vulnerable to the effects of fracking; that is, on the one hand, tribes may be tempted to engage with the oil companies to secure a source of income but, on the other hand, must often engage in legal battles to protect their sovereign rights and the natural resources of their land (Weber et al. 2014).

Even other extraction-based (e.g., forestry, fisheries) and agricultural vocations, which often employ residents of these rural, poor communities, come under threat from fracking efforts, as water becomes tainted, land is repurposed, and the soil becomes poisoned (Perry

2012). In one example exploring a sample of Australian farmers, respondents reported both farm-related (e.g., impact on profitability, disruption to operations) and non-farm related (e.g., health concerns) concerns about coal seam gas extraction, or fracking. Competition for resources between farmers and oil companies contributes to stress for agricultural workers and their families, as well as to a community-level “us versus them” mentality that creates community distress (Morgan et al. 2016). In a Germany-based risk assessment of oil extraction, funded by ExxonMobil, it was noted that tourism, agriculture, and nature conservation are negatively impacted, and community members become distressed when fracking occurs nearby—these impacts on the ability of a community to sustain itself may be irreversible in the damage they commit (Ewen et al. 2012). Further, these deleterious injuries to the communities and the land are intergenerational in nature, in that their effects will continue to exert a negative influence for generations to come. Thus, the applicability of the concept of historical trauma to the community experience of fracking seems appropriate.

Collective Trauma as a Result of Fracking As we have noted throughout, there are both tangible and intangible changes to communities impacted by fracking and, as has happened historically in extraction-impacted and boomtown communities (i.e., gold rush, oil drilling, logging, mountaintop mining), there are typically poor health consequences as a result. These poor outcomes occur at both the individual level, in the form of physical and mental health difficulties, and the level of the community, with changes often occurring in the quality of life, morbidity, and mortality. Sociopolitical stressors, town hall conflicts, and differences of opinions often divide communities and make enemies of neighbors (Jacquet 2014). The persistent, deleterious biopsychosocial impact to people and communities affected by fracking can be conceptualized as a form of collective trauma, from which communities may struggle to recover once the boom is over and the bust begins. In an ethnographic study of a community affected by the Marcellus shale gas boom, Perry interviewed community members, who reported that the arrival of the gas industry signaled a change in the way they viewed and interacted with their land, neighbors, and the larger community, forever altering their family histories and memories and engendering feelings of loss and sadness (Perry 2013). In a series of focus groups, Sangaramoorthy and colleagues found that fracking disrupts a person’s sense of place and social identity, changing relationships, and generates widespread social distress, including uncertainty, anger, fear, and anxiety (Sangaramoorthy et al. 2016).

This often insidious damage to the collective psyche and social structure of impacted communities involves many factors, including actual aesthetic damage to the landscape; removal of valuable resources (often without long-lasting benefit to the community); erosion of socioeconomic base and tourism; destruction of historical, heritage, and sacred sites; a sense of loss of control (e.g., loss of land or livelihood); and a sense of being bullied by the government and the industry (Vaneckova and Bambrick 2014; Brake and Addo 2014). As well, the invasive techniques of fracking and its environmental consequences, including flowback and increased risk of tremors and earthquakes, are sometimes referred to as an assault—as a “raping” of the land—and a removal of innocence from communities (Tosh and Gislason 2016). In a review of health risks related to fracking, Moss and colleagues noted that communities, often rural, experience sustained stress from the incursion of oil and gas companies (Moss, Coram, & Blashki, 2016). This stress contributes to poor community health and well-being, in part due to what is conceptualized as “solastalgia,” or the distress produced by environmental change that results in the loss of sense of place, threats to health, and powerlessness (Albrecht et al. 2007).

Mental Health of Oil and Gas Workers We would be remiss if we did not also mention the psychosocial impact of fracking on the transient workers that flock to the natural gas fields, leaving behind families to enter a culture of hyper-masculinity, dangerousness, and rurality. As noted by Angel (2014), “frontier masculinity,” often associated with resource extraction vocations, involves rugged individualism, emotional toughness, and self-reliance and often results in an internalization of stressors until a psychopathology emerges (Angel 2014). Angel (2014) also describes the changing face of oil and gas workers over time, as an increasing number of “family men” move to rural and frontier areas in search of increased wages, leaving behind support systems and normal routines. In a review of fracking-related health risks, Moss and colleagues noted that social isolation, among other factors, may contribute to substance misuse and violence in mobile, or fly-in, fly-out (FIFO), workers (Moss et al. 2016). It should also be noted that these transient workers sometimes do bring their families, and this has contributed to increased child protective and foster care cases in affected areas, increased domestic violence and usage of women’s shelters, and increased food insecurity and distribution of food stamps. In addition, many transient workers (and their families, when present) end up homeless, often due to unavailability of housing or exorbitant rental prices (Weber et al. 2014).

Thus, there exists a mobile population of workers who may be experiencing psychological distress but may be stigmatized against seeking help and may also not have access to resources or health benefits in their host communities. Indeed, the host communities themselves are often hostile to incoming workers, whom they view as “ruining” their communities by depleting environmental and social resources and creating hazards and danger; as such, mobile workers are often viewed as “dirty” outsiders by communities, depriving these vulnerable groups of workers opportunities to interpersonally and socially engage with a community (Filteau 2015). For instance, in a study of a boomtown in Utah, community members experienced an anticipatory shift in their attitudes and beliefs upon gaining knowledge of the impending arrival of mobile workers, manifesting increased fear and decreased trust (Brown et al. 2005). The literature on the mental health of mobile gas/oil workers and on their relationships with host communities is sparse. Future work is needed to better understand the psychological needs of mobile workers and how host communities can best provide needed services to these often overlooked populations.

Implications

The findings emerging from our literature review, documenting the potentially deleterious effects of fracking on psychological and behavioral health, may have research, clinical, and policy implications. From a psychoeducational perspective, practitioners are encouraged to consider providing education and sources of factual, objective information to communities regarding both actual and perceived risks of fracking to environmental and community health, fears about which can negatively impact psychological well-being. Practitioners can also advocate for the development and implementation of training for healthcare workers, including mental healthcare professionals, that will increase knowledge about the challenges facing both community members and mobile workers in the context of fracking and how best to treat them medically and psychologically (Korfmacher et al. 2013). Finally, advocates and governmental officials may work most effectively together with constituents, using a community-based participatory approach to prepare in advance for the onset of fracking activities in a

community, and can utilize a safety monitoring board to insure that industries adhere to local regulations (Haggerty and McBride 2016). Such community engagement can lead to a sense of empowerment, rather than powerlessness, in the context of fracking and has the potential to promote resilience and prevent increased severity of adverse consequences for affected individuals and communities.

Clinicians working with fracking-affected community members or mobile workers should be aware of the plethora of potential stressors possible, including existential concerns about their community legacy, how to address those concerns, and how to resolve access to care issues for transient workers who may be experiencing mental health problems (Saber 2013). Understanding the connection of the often rural fracking communities to the land, particularly for indigenous groups, farmers, and especially for those responding from a spiritual/existential perspective, may be important for clinicians, as well as the clergy. Indeed, a modern paradigm of pastoral care, ecotheology, seeks to focus on the deep-rooted, spiritual connection that some persons and groups have with the land they have cared for, often for generations (Connor 2013).

With regard to research, as well as future development of shale gas operations, it will be the role of environmental neuroethicists to critically evaluate the impact of fracking on mental health and neurological development (Cabrera et al. 2016). Ecopsychologists and environmental psychologists must undertake an investigation of the psychosocial and sociocultural ramifications of fracking, including the long-term impact to communities and cultures. Clinical and social psychologists should consider an investigation of potential mediators and moderators of the fracking-psychopathology linkage, including individual-level and community-level risks and protective factors that may exacerbate or ameliorate, respectively, the impact of fracking on health, well-being, and quality of life. Funding specifically designed to examine the short- and long-term mental and physical effects of fracking at the individual and community levels should be prioritized across federal agencies, as the effects cross the missions of agencies ranging from the National Institute of Mental Health, the National Institute of Occupational Safety and Health, and the Environmental Protection Agency. Coordination of funding opportunities across the federal landscape could help direct much needed resources to provide the baseline level of knowledge necessary to begin constructing initiatives to counteract fracking's negative effects.

With regard to policy, it is recognized that the industry and the government need to include assurances of individual and community well-being in the planning and execution of any energy generation projects, such as fracking. For instance, in an independent review of fracking by the Public Health Association of Australia, it is noted that the “amenity provided to humans by access to unspoiled natural places is significant for wellbeing” and, conversely, that fracking is detrimental to local and natural environments, thereby jeopardizing well-being (Moore 2013). In the developmental phases of resource extraction, it is critical that psychologists, sociologists, and ethnologists be included in the conduct of “social impact assessments” so that, in addition to the evaluation of demographic and economic factors, there is also attentiveness to disadvantaged and marginalized groups, a focus on capacity building, and empowerment of communities. In addition to insuring the health of their community members, local governments can get involved in the promotion of mental health for mobile gas/oil workers in their communities by enacting land use ordinances that stipulate the provision of adequate physical and mental healthcare by employers (Minor 2014).

From a social justice and psychological activism perspective, grassroot organizations, as well as indigenous groups, have recently been using legal avenues (e.g., for Native American/

American Indian, their legal status and cultural heritage) to challenge and enact change in industry and government decision-making. As such, community organizers and community health practitioners may be able to engender change by encouraging constituents to appeal to the judicial system to block fracking in communities or, at the very least, to compel the larger oil/gas industry to address broader health issues, such as the provision of mental health resources, to communities forced to endure shale gas extraction efforts (Ward et al. 2016; Garvie and Shaw 2015). At the community level, recognizing the critical importance of allowing residents to democratically participate in the decision-making process about fracking activities within their community and providing transparency and accountability may help to empower community members and reduce collective anxiety (Haggerty and McBride 2016; Wheeler et al. 2015).

Conclusions

Overall, in our review of the literature, we found that hydraulic fracturing, or fracking, remains a poorly understood yet controversial energy extraction technique that appears to be related to poor physical, social, and psychological consequences for impacted communities and community members, who are often rural and poor. Spanning neurological, psychopathological, interpersonal, and existential concerns, there appears to be an array of levels of psychosocial functioning that are deleteriously affected by the fracking process and industries and their aftermath. Although much of the research linking fracking to psychological functioning is preliminary or embedded in impact statements and white papers, it is hard to ignore the consistency of findings that point to widespread and potentially permanent effects on mental health. Thus, our literature review provides an important first step in understanding the psychological toll that this energy development strategy has on fracking communities and sets the stage for advancements in research, clinical and policy, that will help us to better understand, assist, and advocate for those affected by fracking.

Compliance with Ethical Standards

Conflicts of Interest The authors declare that they have no conflicts of interest.

References

- Albrecht, G., Sartore, G. M., Connor, L., Higginbotham, N., Freeman, S., Kelly, B., et al. (2007). Solastalgia: the distress caused by environmental change. *Australasian Psychiatry*, *15*(sup1), S95–S98.
- Angel, A. (2014). *Beyond the "roughneck" stereotype: revealing the actual face of mobile workers in the Alberta oil sands and North Dakota's Bakken oil region and why it matters to health*. White Paper, 08.14. Target Logistics. Downloaded from: http://www.targetlogistics.net/1_pdfs/white-papers/BeyondtheRoughneckStereotypeWhitePaper.pdf.
- Balise, V. D., Meng, C. X., Cornelius-Green, J. N., Kassotis, C. D., Kennedy, R., & Nagel, S. C. (2016). Systematic review of the association between oil and natural gas extraction processes and human reproduction. *Fertility and Sterility*, *106*(4), 795–819.
- Bamberger, M., & Oswald, R. E. (2012). Impacts of gas drilling on human and animal health. *New Solutions: A Journal of Environmental and Occupational Health Policy*, *22*(1), 51–77.
- Brake, W., & Addo, E. (2014). Tourism and 'fracking' in Western Newfoundland: interests and anxieties of coastal communities and companies in the context of sustainable tourism. *International Journal of Marine Science*, *4*(2), 16–41. doi:10.5376/ijms.2014.04.0002.

- Brasier, K., Davis, L., Kelsey, T., McLaughlin, D., Schafft, K., Babbie, K. et al. (2014). *The Marcellus shale impacts study: chronicling social and economic change in North Central and Southwest Pennsylvania*. Center for Rural Pennsylvania. Retrieved from: <http://www.rural.palegislature.us/documents/reports/The-Marcellus-Shale-Impacts-Study.pdf>
- Brown, R. B., Dorins, S. F., & Krannich, R. S. (2005). The boom-bust-recovery cycle: dynamics of change in community satisfaction and social integration in Delta, Utah. *Rural Sociology*, 70(1), 28–49.
- Cabrera, L. Y., Tesluk, J., Chakraborti, M., Matthews, R., & Illes, J. (2016). Brain matters: from environmental ethics to environmental neuroethics. *Environmental Health*, 15(1), 1.
- Carey, M. (2012). Coal seam gas: future bonanza or toxic legacy? *Viewpoints*, 8, 26–31.
- Castelli, M. (2015). Fracking and the rural poor: negative externalities, failing remedies, and federal legislation. *Indiana Journal of Law and Social Equality*, 3, 281–304.
- Cerros, H. J. (2015). *From a public health perspective: fracking and other unconventional oil and gas extraction techniques in California*. Retrieved from <http://repository.usfca.edu/capstone/187>
- Chapman, D. P., Perry, G. S., & Strine, T. W. (2005). The vital link between chronic disease and depressive disorders. *Preventing Chronic Disease*, 2(1), A14.
- Clough, E., & Bell, D. (2016). Just fracking: a distributive environmental justice analysis of unconventional gas development in Pennsylvania, USA. *Environmental Research Letters*, 11(2), 025001.
- Colborn, T., Schultz, K., Herrick, L., & Kwiatkowski, C. (2014). An exploratory study of air quality near natural gas operations. *Human and Ecological Risk Assessment: An International Journal*, 20(1), 86–105.
- Connor, L. R. (2013). *Justified by faith: the upper Susquehanna Lutheran synod and the Pennsylvania natural gas fracking controversy*. Retrieved from http://scholarship.claremont.edu/pomona_theses/83/
- Coram, A., Moss, J., & Blashki, G. (2014). Harms unknown: health uncertainties cast doubt on the role of unconventional gas in Australia's energy future. *The Medical Journal of Australia*, 4, 210–213.
- Crowe, J., Silva, T., Ceresola, R. G., Buday, A., & Leonard, C. (2015). Differences in public perceptions and leaders' perceptions on hydraulic fracturing and shale development. *Sociological Perspectives*, 58(3), 441–463.
- Drummond, V., & Grubert, E. (2017). Fault lines: seismicity and the fracturing of energy narratives in Oklahoma. *Energy Research & Social Science*. doi:10.1016/j.erss.2017.05.039.
- England, J. L., & Albrecht, S. L. (1984). Boomtowns and social disruption. *Rural Sociology*, 49(2), 230–246.
- Evensen, D., & Stedman, R. (2015). Fracking: promoter and destroyer of the good life. *Journal of Rural Studies*. doi:10.1016/j.jrurstud.2017.02.020.
- Ewen, C., Borchart, D., Richter, S., & Hammerbach, R. (2012). Hydrofracking risk assessment: Study concerning the safety and environmental comparability of hydrofracking for natural gas production from unconventional reservoirs (Executive Summary). Berlin: Exxon Mobil.
- Ferrari, K. J., Kriesky, J., Christen, C. L., Marshall, L. P., Malone, S. L., Sharma, R. K., et al. (2013). Assessment and longitudinal analysis of health impacts and stressors perceived to result from unconventional shale gas development in the Marcellus shale region. *International Journal of Occupational and Environmental Health*, 19(2), 104–112. doi:10.1179/2049396713Y.0000000024.
- Ferrari, K. D. (2013). *Rural communities: how do individuals perceive change when industry enters the area?* Available from graduate theses and dissertations. Retrieved from <http://scholarcommons.usf.edu/etd/4813>
- Filteau, M. R. (2015). Go back to Texas, gas bastards! How a newcomer population of itinerant energy workers manage dirty work stigma in the Marcellus shale region. *Society & Natural Resources*, 28(11), 1153–1167.
- Garvie, K. H., & Shaw, K. (2015). Shale gas development and community response: perspectives from Treaty 8 territory, British Columbia. *Local Environment*, 21(8), 1009–1028. doi:10.1080/13549839.2015.1063043.
- Haggerty, J., & McBride, K. (2016). Does local monitoring empower fracking host communities? A case study from the gas fields of Wyoming. *Journal of Rural Studies*, 43, 235–247.
- Illes, J., Davidson, J., & Matthews, R. (2014). Environmental neuroethics: changing the environment—changing the brain. Recommendations submitted to the Presidential Commission for the Study of Bioethical Issues. *Journal of Law and the Biosciences*, 1(2), 221–223.
- Jacquet, J. B. (2014). Review of risks to communities from shale energy development. *Environmental Science & Technology*, 48(15), 8321–8333.
- Jacquet, J. B., & Kay, D. L. (2014). The unconventional boomtown: updating the impact model to fit new spatial and temporal scales. *Journal of Rural and Community Development*, 9(1), 1–23.
- Jaspal, R., Turner, A., & Nerlich, B. (2014). Fracking on YouTube: exploring risks, benefits and human values. *Environmental Values*, 23(5), 501–527.
- Jemielita, T., Gerton, G. L., Neidell, M., Chillrud, S., Yan, B., Stute, M., et al. (2015). Unconventional gas and oil drilling is associated with increased hospital utilization rates. *PLoS One*, 10(7), e0131093. doi:10.1371/journal.pone.0131093.
- Korfmacher, K. S., Jones, W. A., Malone, S. L., & Vinci, L. F. (2013). Public health and high volume hydraulic fracturing. *New Solutions: A Journal of Environmental and Occupational Health Policy*, 23(1), 13–31.

- Lai, P.-H., Lyons, K. D., Gudergan, S. P., & Grimstad, S. (2017). Understanding the psychological impact of unconventional gas developments in affected communities. *Energy Policy*, *101*, 492–501. doi:10.1016/j.enpol.2016.11.001.
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., et al. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Medicine*, *6*(7), e1000100.
- Maguire, K., & Winters, J. V. (2016). *Energy boom and gloom? Local effects of oil and natural gas drilling on subjective well-being (9811)*. Retrieved from: <http://ssrn.com/abstract=2750294>
- Mauro, I., MacGregor, M., & Wheeler, D. (2014). *Discussion paper: the environmental impacts of hydraulic fracturing in Nova Scotia—a public participatory risk assessment*. Retrieved from: <http://nlhfrp.ca/wp-content/uploads/2015/01/Discussion-Paper-Environment-Impacts.pdf>
- McCoy, D., & Saunders, P. (2016). *Health and fracking: the impacts and opportunity costs*. Medact. Retrieved from: http://www.medact.org/wp-content/uploads/2015/04/medact_fracking-report_WEB4.pdf
- McDermott-Levy, R., & Garcia, V. (2016). Health concerns of northeastern Pennsylvania residents living in an unconventional oil and gas development county. *Public Health Nursing*, *33*(6), 502–510. doi:10.1111/phn.12265.
- McDermott-Levy, R., Kaktins, N., & Sattler, B. (2013). Fracking, the environment, and health. *American Journal of Nursing*, *113*(6), 45–51.
- McKenzie, L. M., Witter, R. Z., Newman, L. S., & Adgate, J. L. (2012). Human health risk assessment of air emissions from development of unconventional natural gas resources. *Science of the Total Environment*, *424*, 79–87.
- Measham, T. G., Fleming, D. A., & Schandl, H. (2016). A conceptual model of the socioeconomic impacts of unconventional fossil fuel extraction. *Global Environmental Change*, *36*, 101–110.
- Minor, J. (2014). Local government fracking regulation: a Colorado case study. *Stanford Environmental Law Journal*, *61*(1), 62.
- Moore, M. (2013). *The independent review of coal seam gas activities in NSW (human health and environment effects)*. Public Health Association of Australia. Downloaded from: <https://www.phaa.net.au/documents/item/400>.
- Morgan, M. I., Hine, D. W., Bhullar, N., Dunstan, D. A., & Bartik, W. (2016). Fracked: coal seam gas extraction and farmers' mental health. *Journal of Environmental Psychology*, *47*, 22–32.
- Morrone, M., Chadwick, A. E., & Kruse, N. (2015). A community divided: hydraulic fracturing in rural Appalachia. *Journal of Appalachian Studies*, *21*(2), 207–228.
- Moss, J., Coram, A., & Blashki, G. (2016). *Is fracking good for your health? An analysis of the impacts of unconventional gas on health and climate* (Technical Report 28). Retrieved from: <http://www.tai.org.au/content/fracking-good-your-health> .
- Paylor, A. (2017). The social-economic impact of shale gas extraction: a global perspective. *Third World Quarterly*, *38*(2), 340–355. doi:10.1080/01436597.2016.1153420.
- Perry, S. L. (2012). Development, land use, and collective trauma: the Marcellus shale gas boom in rural Pennsylvania. *Culture, Agriculture, Food and Environment*, *34*(1), 81–92. doi:10.1111/j.2153-9561.2012.01066.x.
- Perry, S. L. (2013). Using ethnography to monitor the community health implications of onshore unconventional oil and gas developments: examples from Pennsylvania's Marcellus shale. *New Solutions: A Journal of Environmental and Occupational Health Policy*, *23*(1), 33–53.
- Powers, M., Saberi, P., Pepino, R., Strupp, E., Bugos, E., & Cannuscio, C. C. (2015). Popular epidemiology and fracking: citizens' concerns regarding the economic, environmental, health and social impacts of unconventional natural gas drilling operations. *Journal of Community Health*, *40*(3), 534–541.
- Redmond, H., & Faulkner, K. (2013). *Submission on the Camden gas project stage 3 northern expansion*. Doctors for the Environment Australia. Downloaded from: https://www.dea.org.au/images/uploads/submissions/Camden_Gas_Project_Stage_3_Submission_01-13.pdf.
- Resick, L. K., Knestruck, J. M., Counts, M. M., & Pizzuto, L. K. (2013). The meaning of health among mid-Appalachian women within the context of the environment. *Journal of Environmental Studies and Sciences*, *3*(3), 290–296. doi:10.1007/s13412-013-0119-y.
- Ruddell, R., Jayasundara, D. S., Mayzer, R., & Heitkamp, T. (2014). Drilling down: an examination of the boom-crime relationship in resource-based boom countries. *Criminology, Crim.Just.L & Soc'y*, *15*, 3.
- Saberi, P. (2013). Navigating medical issues in shale territory. *New Solutions: A Journal of Environmental and Occupational Health Policy*, *23*(1), 209–221.
- Saberi, P., Propert, K. J., Powers, M., Emmett, E., & Green-McKenzie, J. (2014). Field survey of health perception and complaints of Pennsylvania residents in the Marcellus shale region. *International Journal of Environmental Research and Public Health*, *11*(6), 6517–6527.
- Sangaramoorthy, T., Jamison, A. M., Boyle, M. D., Payne-Sturges, D. C., Sapkota, A., Milton, D. K., et al. (2016). Place-based perceptions of the impacts of fracking along the Marcellus shale. *Social Science & Medicine*, *151*, 27–37.

- Short, D., & Szolucha, A. (2017). Fracking Lancashire: the planning process, social harm and collective trauma. *Geoforum*. doi:10.1016/j.geoforum.2017.03.001.
- Steinzor, N., Subra, W., & Sumi, L. (2013). Investigating links between shale gas development and health impacts through a community survey project in Pennsylvania. *New Solutions: A Journal of Environmental and Occupational Health Policy*, 23(1), 55–83.
- Szolucha, A. (2016). *The human dimensions of shale gas development in Lancashire, UK: toward a social impact assessment*. Retrieved from: <http://repowerdemocracy.net/report>
- Tosh, J., & Gislason, M. (2016). Fracking is a feminist issue: an intersectional ecofeminist commentary on natural resource extraction and rape. *Psychology of Women Section Review*, 1–12.
- Tucker, C. (2012). Health concerns of fracking drawing increased attention: EPA conducting studies on health effects. *The Nation's Health*, 42(2), 1–14.
- Vaneckova, P., & Bambrick, H. (2014). *Approaches to baseline studies of human health in relation to industries with potential environmental impact*. Centre for Health Research, University of Western Sydney. Downloaded from: http://www.chiefscientist.nsw.gov.au/_data/assets/pdf_file/0005/56894/140903_Human-CSG_completed_report.pdf.
- Ward, H., Eykelbosh, A., & Nicol, A. M. (2016). Addressing uncertainty in public health risks due to hydraulic fracturing. *Environmental Health Review*, 59(2), 57–61.
- Watterson, A., & Dinan, W. (2015). Health impact assessments, regulation, and the unconventional gas industry in the UK: exploiting resources, ideology, and expertise? *New Solutions: A Journal of Environmental and Occupational Health Policy*, 25(4), 480–512. doi:10.1177/1048291115615074.
- Weber, B. A., Geigle, J., & Barkdull, C. (2014). Rural North Dakota's oil boom and its impact on social services. *Social Work*, 59(1), 62–72.
- Werner, A. K., Vink, S., Watt, K., & Jagals, P. (2015). Environmental health impacts of unconventional natural gas development: a review of the current strength of evidence. *Science of the Total Environment*, 505, 1127–1141.
- Wheeler, D., MacGregor, M., Atherton, F., Christmas, K., Dalton, S., Dusseault, M., et al. (2015). Hydraulic fracturing: integrating public participation with an independent review of the risks and benefits. *Energy Policy*, 85, 299–308.
- Witter, R. Z., Stinson, K., Sackett, H., Putter, S., Kinney, G., Teitelbaum, D. et al. (2008). *Potential exposure-related human health effects of oil and gas development: A white paper*. Colorado School of Public Health. Downloaded from: https://www.nrdc.org/sites/default/files/hea_08091702a.pdf.
- Witter, R. Z., McKenzie, L., Towle, M., Stinson, K., Scott, K., Newman, L. et al. (2010). *Health impact assessment for Battlement Mesa, Garfield County Colorado*. Colorado School of Public Health. Downloaded from: <https://www.garfield-county.com/environmental-health/battlement-mesa-health-impact-assessment-draft2.aspx>.