Indigenous communities and the mental health impacts of land dispossession related to industrial resource development: a systematic review

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Globally, many resource extraction projects such as mines and hydroelectric dams are developed on the territories of Indigenous Peoples. Recognising land as a determinant of Indigenous Peoples' health, our objective is to synthesise evidence about the mental health impacts on Indigenous communities who experience land dispossession due to industrial resource development (mining, hydroelectric, petroleum, and agricultural). We systematically reviewed studies that focused on Indigenous land dispossession in Australia, Aotearoa (New Zealand), North and South America, and the Circumpolar North. We searched Scopus, Medline, Embase, PsycINFO, and Global Health on OVID for peer-reviewed articles published in English from database inception to Dec 31, 2020. We also searched for books, research reports, and scholarly journals specialising in Indigenous health or Indigenous research. We included documents that reported on primary research, focused on Indigenous Peoples in settler colonial states, and reported on mental health and industrial resource development. Of the 29 included studies, 13 were related to hydroelectric dams, 11 to petroleum developments, nine to mining, and two to agriculture. Land dispossession due to industrial resource development had predominantly negative mental health impacts on Indigenous communities. The impacts were consequences of colonial relations that threatened Indigenous identities, resources, languages, traditions, spirituality, and ways of life. Health impact assessment processes in industrial resource development must expressly consider risks and potential impacts on mental health and respect Indigenous rights by making knowledge about mental health risks a central component to decisions about free, prior, and informed consent.

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Introduction

Indigenous Peoples' relationship with the land is a key determinant of health and wellness.[1–7] This relationship is central to Indigenous knowledge systems (ways of knowing, being, and doing), culture, and survival.[8–13] Indigenous Peoples view the land and its resources as inseparable from individual and collective identities; land forms the basis of social relationships, livelihoods, and wellbeing.[12,14–16]

The estimated 475 million Indigenous Peoples in 90 countries collectively occupy approximately a quarter of the earth's surface and are stewards for 80% of global biodiversity.[17] Yet, many tribes and nations do not have formal control over their territories and natural resources, and in some countries, they do not have legal recognition by the state.[18–20] In settler colonies such as Australia, Canada, and the USA, colonial governments in power might publicly state that Indigenous communities have the right to occupy, use, and control land; however, in reality, only some communities and parts of Indigenous lands are legally recognised by the colonial government.[21–24] In other countries, such as the Philippines, South Sudan, and Uganda, Indigenous Peoples must engage in unclear, expensive, and time-consuming processes to have legal protection of their lands.[24] In contrast to Indigenous knowledge systems, colonial systems involve controlling, owning, and governing land for economic, political, and social gains.[21,22,25] Through these gains, colonial governments have disrupted the relationship between Indigenous Peoples and the land through dispossession for economic or state development purposes.[26–28]

Land dispossession—the taking or using of Indigenous land without consent—has contributed to a loss of language and culture, interrupted the transmission of knowledge, and become a source of intergenerational trauma.[3,29–38] Cumulatively, land dispossession and its consequences have entrenched the disparate health outcomes experienced by Indigenous Peoples globally.[12,39–42]

Since World War 2, economic development centred on resource extraction has grown substantially worldwide.[43] Mining, agriculture, hydroelectric dams, and petroleum industries (hereinafter referred to as industrial resource development) have had substantial direct and indirect adverse effects on the environment, due to their physical footprint and downstream effects.[44–46] Such developments modify terrestrial and aquatic landscapes, and in many cases, lead to community displacements or substantial changes to the social and economic life for community members.[47–53] Previous research suggests that communities experience elevated risks for various social, physical health, and mental health problems associated with environmental and economic changes within their homelands.[29,54,55] Indigenous communities have often not consented to, or have been excluded from, meaningful involvement in decision-making processes about resource extraction or other industrial scale projects,[47,56,57] and they are also often not involved in health impact assessment processes. This exclusion means that Indigenous-specific dimensions of health can go underappreciated and unmeasured.[58]

For many Indigenous Peoples, mental health is closely connected with physical, spiritual, and emotional health, and is strongly tied to relationships with families,

communities, and the environment.[12,42,59–63] Because of the central role of land as a determinant of health, the displacement of communities and land dispossession often have deleterious effects on Indigenous Peoples. The extent and pathways for these effects have not been comprehensively examined, particularly in the context of industrial resource development,[64–69] and studies about mental health are especially scarce.[34] The objective of this systematic review is to examine the reported effects of land dispossession due to mining, hydroelectric, petroleum (oil and gas), and agricultural developments on mental health in Indigenous communities.

See Online for appendix 1

Methods

This systematic review was initiated by the West Moberly First Nations, an Indigenous nation located in the western subarctic of Canada. The community-centred process involved creating a local advisory team to identify the scope of the review, inform the study design, and review the findings. The study is reported according to the PRISMA guidelines.[70] This Review was registered with the International Prospective Register of Systematic Reviews (CRD42021253720). The methods are described in detail in the protocol.[71]

Search strategy and selection criteria

The detailed search strategies for the databases and sources consulted are reported in appendix 1 (pp 7–19). Between Dec 19, 2020, and Jan 2, 2021, a health sciences librarian (JL) searched Scopus, Medline, Embase, PsycINFO, and Global Health on OVID for peer-reviewed articles published in English from database inception to

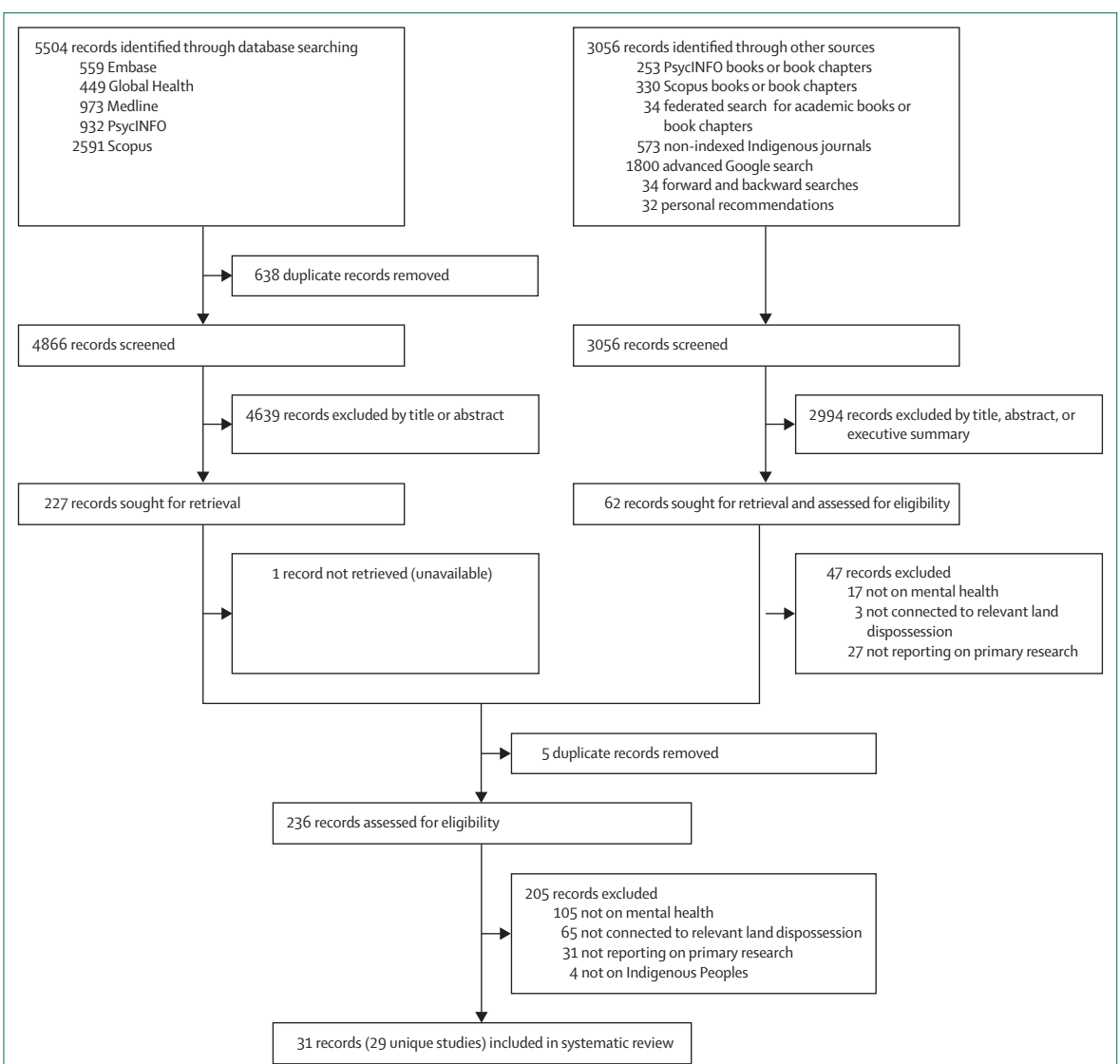

Figure 1: **Study selection**

Dec 31, 2020. JL searched for books and book chapters published between 2000 and 2020 within PsycINFO (Jan 1, 2021) and Scopus (March 24, 2021, and Nov 28, 2021), and using the Ex Libris Primo library discovery search engine for a federated search of the University of Manitoba Libraries book collections, along with the book collections of several other academic libraries (April 1, 2021). We searched for grey literature on Oct 27, 2021, using Google advanced search techniques to identify literature published by governments and community-based or non-governmental organisations, and academic reports or theses. Additionally, we reviewed individual journals specialising in Indigenous health or Indigenous research to include all possible relevant articles, especially because many of these journals are not indexed in the major biomedical databases. We manually screened the table of contents for each issue of these journals to identify additional articles.[71]

The search results were imported into Covidence, where duplicates were removed. Studies were eligible for inclusion if they reported on primary research; focused on Indigenous communities located in Australia, Aotearoa (New Zealand), North or South America, or countries within the Circumpolar North; reported on mental health risk or protective factors, experiences, outcomes, or impacts; and were related to land dispossession due to dams, mines, agriculture, or petroleum.

Four authors (MEMN, NB, NJP, and AL) screened the documents, with each title and abstract being independently screened by two authors. Full-text agreement between reviewers (MEMN, NB, NTGG, JRR, and AL), assessed with Cohen's κ, was 0·76—ie, moderately strong agreement. Assessments that differed were resolved by consensus. Five authors (MEMN, NB, NTGG, JM, and LJB) reviewed all studies included after full-text review, with each study being appraised independently by two authors, using a modified critical appraisal skills programme (CASP) qualitative studies checklist (appendix 1 pp 2–3).[72]

Data analysis

Five reviewers (MEMN, NB, NTGG, JM, and LJB) independently recorded the type of source (journal article, government report, etc), demographic information, research questions and methods, level of Indigenous Peoples' involvement,[73] and tools and indicators used to report on mental health impacts and outcomes. Two of five authors recorded information for each publication. All extracted information was then shared with the team for analysis. After discussing initial observations from the extracted data, team members did three rounds of coding, identified themes, and drafted figures that illustrated relationships between themes. We used a constant comparative method[74] to synthesise themes within and across included articles. Multiple coders worked on peer debriefing to maximise validity and generate an audit trail for our findings.[75] The themes and conceptual figures were also shared and discussed with all coauthors. To accurately capture the data in our results, we reported direct quotations from Indigenous participants in the included studies to respect experiential knowledge central to local Indigenous knowledge systems.[76,77]

Results

The search identified 8560 records (figure 1). After removing 643 duplicates and excluding 7681 records, we assessed 236 full-text records for eligibility. We identified

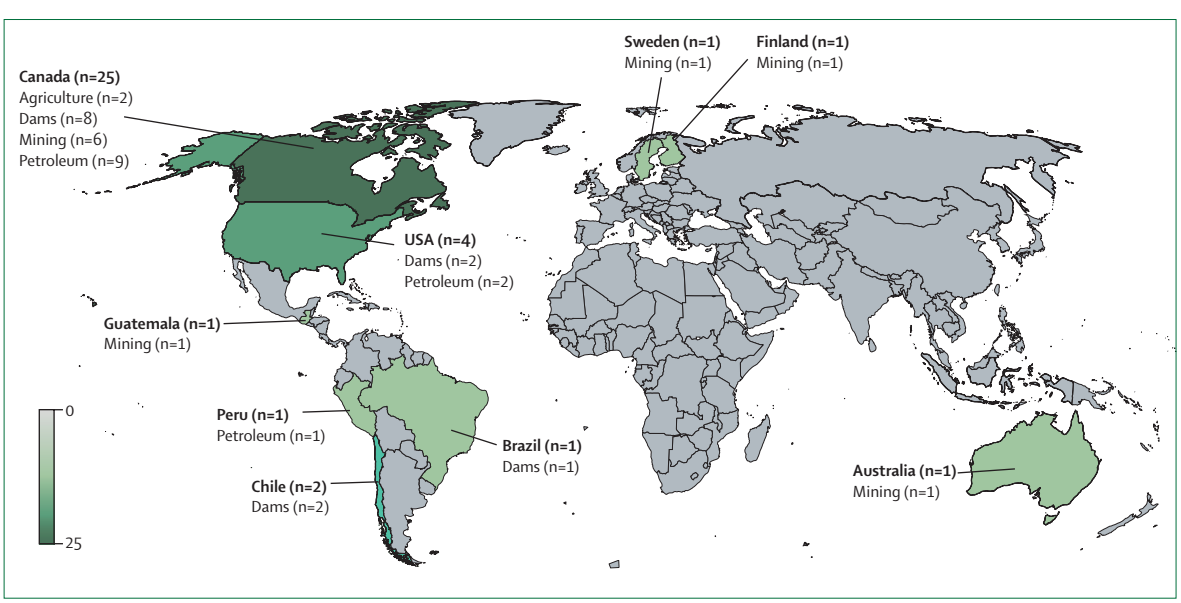

Figure 2: **Map of industrial resource development locations in the included studies**
Some studies included more than one country and some studies included more than one type of industrial resource development; therefore, the total number of studies (n=29) is not reflective of the total number of industrial resource developments shown in this map (n=37).

	Indigenous Peoples (location)	Research questions	Industrial resource development	Study design and methodology	Indigenous Peoples' involvement in governing the research	Summary of findings
Australia						
Petheram et al (2010)[106]	Yolngu of North East Arnhem Land (Northern Territory)	What are the "Yolngu peoples' observations and perspectives on climate change, and their ideas and preferences for adaptation"?[106]	Mining and other developments (tourism and climate change)	Qualitative: interviews and workshops (n=21)	Indigenous stakeholders are named as team members, who are consulted throughout the project regarding research priorities and outcomes	Changes to the landscape from mining greatly affected people's connection to the land that is core to their culture, identity, and wellbeing; despite trying to "be strong",[106] mental health impacts included feeling hurt, frustrated, anxiety, depression, worry, and resentment; there was concern for future generations and their identity, minds, mistreatment, and connection to the land—ie, linking health and wellness with maintenance of culture
Canada						
Ballard et al (2020)[78]	Ojibway of Pinaymootang, Little Saskatchewan, Lake St Martin, Dauphin River, and Lake Manitoba First Nations (Manitoba)	What are "Elders' strategies to heal from the 2011 flood and forced displacement" and how did they define "'maziaya' (not well/not healthy) and 'minoaya' (well-being/healthy)"?[78]	Hydroelectric dam	Qualitative: interviews and discussion groups (n=23)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	Displacement left communities uncertain whether they would be allowed to return; mental health concerns disrupted *minoay awin* (general wellbeing); people experienced trauma through loss, loneliness, sadness, depression, and suicide; stress through anxiety, uncertainty, and food insecurity; racism due to displacement to urban centres; and social impacts through marital breakup and substance use
Booth and Skelton (2011)[80]	Dane-Zaa (also known as Dunne-za), and Cree of West Moberly First Nations, Halfway River First Nation, and Treaty 8 Tribal Association (northern British Columbia)	What are the "physical impacts of industrial development as well as psychological and cultural concerns" and what are "the impacts of First Nations being required to constantly participate in consultative processes"?[80]	Hydroelectric dam, mining, petroleum, agriculture, and other developments (wind farms and guide-outfitting)	Qualitative: interviews and focus groups (n=31)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	Cumulative impacts from multiple industries led to stress from evacuations, increased vehicle traffic, food contamination, and uncertainty for future generations; divisions between communities; increased substance use; and psychological impacts including frustration, anger, hurt, despair, and powerlessness; cultural loss weakened people's spirituality, connection to the land, and identity
Campbell (2007)[100]	Undisclosed Indigenous community (northern Canada)	How do people involved in family violence interventions understand the nature and extent of the problem of family violence?	Hydroelectric dam	Qualitative: interviews (n=22)	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	Relocation from the dam development resulted in experiencing stress and feeling lost, increased social problems such as family and other violence and substance use, loss of connections to culture, and loss of a close-knit community
Gagnon and Desbiens (2018)[103]	Innu of Pessamit (Quebec)	"How does memory work to recall or rebuild *localized* events or emotions when the remembering subject cannot stand *in-place* anymore?"[103]	Hydroelectric dam	Qualitative (phenomenology): interviews, storytelling, cultural and participatory mapping (n=unknown)	Indigenous stakeholders are named as team members, who are consulted throughout the project regarding research priorities and outcomes	After the land was flooded, some people never returned to the land because it did not feel like their land anymore; people experienced desolation and distress from a lack of solace and comfort, due to being dislocated; people who stayed on their homeland experienced solastalgia—ie, feeling homesick while still at home

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	Indigenous Peoples (location)	Research questions	Industrial resource development	Study design and methodology	Indigenous Peoples' involvement in governing the research	Summary of findings
(Continued from previous page)						
Gerbrandt and Westman (2020)[83]	Cree of Woodland Cree First Nation (northern Alberta)	What are the "differences between corporate and media portrayals of the spill and cleanup efforts"[83] and what are emergent themes and concerns of the impacted Woodland Cree First Nation members?	Petroleum (spill)	Qualitative (ethnographic fieldwork): interviews (n=unknown), field notes, and spill summaries	Indigenous stakeholders are named as team members, who are consulted throughout the project regarding research priorities and outcomes	An oil spill caused irreparable changes to land, causing mental health concerns of grief, distress, sadness, anger, uncertainty, and devastation within a community; mental and emotional impacts were associated with ongoing forms of racism and complicated by job creations that benefitted some community members and not others
Hoffman and Martin (2012)[101]	Cree of O-Pipon-Na-Piwin Cree Nation (northern Manitoba)	Using a social capital framework, what are the consequences of removing South Indian Lake's residents for a large hydroelectric project?	Hydroelectric dam	Qualitative: interviews (n=24)	Indigenous stakeholders are named as team members, who are consulted throughout the project regarding research priorities and outcomes	Forced relocation due to flooding led to many disruptions, including placing children in residential schools and moving to a new location; these disruptions greatly impacted family and community networks and ways of life, causing sadness, depression, and trauma from loss; people experienced loss of language, ways of life, and cultural knowledge, and coped using alcohol and drugs; the losses and mental health impacts were also linked to increased domestic violence and suicidal ideation
Jackson (2011)[85]	Anishinaabe of Aamjiwnaang First Nation (southern Ontario)	How do Aamjiwnaang residents experience living in a place that is disrupted by the extraordinary levels of pollution?	Petroleum	Qualitative (ethnographic and archival): meetings and media analysis	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	Being surrounded by the degradation of land caused fear (eg, of breathing in the toxins) and acute anxiety; the combination of concern for the land, including plants and animals, and anxiety caused feelings of dislocation and solastalgia
Kudloo et al (2014)[87] and Czyzewski et al (2016)[82]	Inuit of Qamani'tuaq (Nunavut)	"How has the Meadowbank gold mine impacted Inuit women and families living in Qamani'tuaq (Baker Lake), Nunavut Territory?"[87]	Mining	Mixed methods: focus groups, training workshop, and questionnaires (n=62)	Indigenous stakeholders are active partners, who collaborate with team members throughout the research project	Mining near the community led to increased stress levels that were associated with racism, violence towards women, and increased access to money, drugs, alcohol, and gambling; although money helped afford some camping, hunting, and fishing supplies, the mine changed the way of life, leading to the loss of cultural knowledge, land-based ways of life, and language; many women felt that mental health and suicide prevention services were insufficient
Kulchyski et al (2006)[88]	Cree of Nisichawayasihk Cree Nation (northern Manitoba)	What are the lived experiences of people who were greatly affected by the hydroelectric dam development in the 1960s?	Hydroelectric dam	Qualitative: interviews (n=12), literature review, focus group (n=unknown), community tours, participants' observations (n=unknown), and photojournalism using community participatory research	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	A dam development caused many disruptions including increased community divisions, loss of livelihoods and outmigration, food insecurity and poverty, and experiences of racism; feelings of lost hope, harm from having homes destroyed, and racism led to alcohol use, violence, and intergenerational trauma

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	Indigenous Peoples (location)	Research questions	Industrial resource development	Study design and methodology	Indigenous Peoples' involvement in governing the research	Summary of findings
(Continued from previous page)						
Luginaah et al (2010)[107]	Anishinaabe of Aamjiwnaang First Nation (southern Ontario)	What are the "perceived environmental health effects for members of Aamjiwnaang First Nation within a cultural and historical context", how are Aamjiwnaang residents "coping with their everyday lives in this high exposure environment", and what are "residents' suggestions of what can be done in the current situation"?[107]	Petroleum	Qualitative: interviews (n=18)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	The pollution caused persistent odours that required staying indoors; the fear and concern for the contamination resulted in prolonged stress, fear of health and safety, distrust for the industries, and concern for children's mental wellbeing; some community members coped through forms of acceptance, denial of dangers, and humour, whereas others left the community
Noble and Bronson (2005)[89]	Indigenous Peoples by Saskatchewan uranium mines, Northwest Territories diamond mines, and Labrador Voisey's Bay mine (northern Saskatchewan, Northwest Territories, and northern Newfoundland and Labrador)	Based on three mining case studies, how have health considerations in environmental impact assessment evolved and what is the current nature and scope of health integration?	Mining	Qualitative: key informant interviews (n=24), document review, and field notes	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	The mining projects impacted people's cultural, economic, and spiritual relationships with the land; mental health concerns of stress and the overall social and other health impacts were associated with increased alcoholism, family violence, teenage pregnancies, and suicides
Parlee et al (2012)[92]	Cree of Lesser Slave Lake Region (northern Alberta)	What are the cumulative effects of resource development and how do these effects contribute to efforts to pinpoint thresholds or tipping points of both ecological and socioeconomic change?	Petroleum and agriculture	Qualitative: interviews with each household (n=unknown)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	Contamination from resource developments (petroleum, forestry, and agriculture) affected land and resulted in mental health impacts of grief, loss, and worry; these impacts were also associated with not being able to hunt, eat plants and animals from the land, and transfer traditional knowledge to younger generations
Pufall (2011)[98]	Inuit of Nain, Nunatsiavut (northern Newfoundland and Labrador)	What is the Nunatsiavut Inuit perspective on the "role, importance, and safety of country foods"?[98]	Mining and petroleum	Qualitative: interviews (n=5) and focus groups (n=14)	Indigenous stakeholders are named as team members, who are consulted throughout the project regarding research priorities and outcomes	Mining operations contaminated surrounding land and waters, impacting food sources and sustenance—ways of life that were core to people's identity, traditional values and ways of knowing; mental health impacts included concern for their relationship with the land and fear for the animals and fish, people's wellbeing, and the long-term loss of their ways of knowing, being, and living as part of the land
Shandro et al (2017)[93]	First Nations in 16 communities, Fraser River (British Columbia)	How are First Nations people impacted by the breach of the Mount Polley mine tailings dam and what are the health impacts?	Mining (tailings dam)	Qualitative: literature review, key informant interviews, focus groups, and field and observational notes (n=16 communities)	Indigenous stakeholders are active partners who collaborate with team members throughout the research project	A mine tailings dam was breached and contaminated the surrounding land and waters, causing concerns about the land and community wellbeing as well as increased conflict within the community; mental health impacts included stress, anger, sadness, fear, and confusion; the contamination made it unsafe to continue land-based and cultural ways of life, such as relying on the land for food and medicine

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	Indigenous Peoples (location)	Research questions	Industrial resource development	Study design and methodology	Indigenous Peoples' involvement in governing the research	Summary of findings
(Continued from previous page)						
Smith et al (2010)[94]	Anishinaabe of Aamjiwnaang First Nation (southern Ontario)	How has the contamination of Aamjiwnaang First Nation impacted residents' perceptions of the therapeutic nature of the landscape and what are residents' perceptions of changes in their relationship with Mother Earth as a result of environmental contamination?	Petroleum	Qualitative: interviews (n=18)	Indigenous stakeholders are active partners, who collaborate with team members throughout the research project	Oil and other petrochemical industries have surrounded a community, polluting the land, water, and air; the pollution made the land and water unsafe for people to harvest medicines, visit sacred places of healing, and engage in other land-based traditional ways of life essential to their wellbeing; mental health concerns were linked to stress about the pollution and not having access to land as a place of health and wellness; people experienced sadness, worry, distress, disillusionment, fear, and concern for future generations
Spiegel et al (2020)[95]	Coast Salish of Tsleil-Waututh Nation (southern British Columbia)	What are the stories of health, environmental, and intergenerational justice concerns of the Tsleil-Waututh Nation, situated at the terminal of the contested Trans Mountain pipeline and tanker expansion project?	Petroleum	Qualitative: modified photovoice (n=unknown)	Indigenous stakeholders are active partners, who collaborate with team members throughout the research project	Concerns about contamination from oil were associated with the water and food chain; the contamination caused feelings of stress, anxiety, distrust, hurt, and sadness; people reported negative impacts to traditional foods and food sustenance, cultural ways of knowing, being, and living, blood memory, and spiritual relationships with the earth
Tobias and Richmond (2014)[96]	Anishinaabe of Batchewana First Nation of Ojibways and Ojibways of the Pic River First Nation (Ontario)	What are the "perceived health impacts of environmental dispossession among Elders in two Anishinaabe communities in Ontario, Canada"?[96]	Mining and hydroelectric dam	Qualitative: interviews (n=46)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	Land and environmental dispossession from mining and hydroelectric dams led to health impacts; people spoke of their close relationship with the land and importance of sharing traditional knowledge through cultural ways of knowing, being, and living on the land; mental health impacts of land dispossession included feelings of hurt, and resilience was experienced through being on the land
Yaremko (2018)[97]	Cree of O-Pipon-Na-Piwin Cree Nation, Chemawawin First Nation, and South Indian Lake (northern Manitoba)	What are "the deep systematic connections between First Nations people and the destruction of land and water in northern Manitoba"?[97]	Hydroelectric dam	Qualitative: oral history interviews (n=8)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	Dam flooding led to a forced relocation of a community; homelands were no longer safe for travel and the lake's ecosystem was destroyed; the land was central to the community's livelihood, traditional knowledge, and way of life before the dam flooding; stress and trauma from the relocation and loss of connection to the land was linked to reports of violence, family breakdowns, and substance use

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	Indigenous Peoples (location)	Research questions	Industrial resource development	Study design and methodology	Indigenous Peoples' involvement in governing the research	Summary of findings
(Continued from previous page)						
Canada and USA						
Gill and Ritchie (2020)[84]	Tsimshian of Gitga'at First Nation and Alaska Natives (coastal British Columbia, Canada; Alaska, USA)	What are the "cumulative sociocultural and psychosocial effects of technological hazards and disasters",[84] using the Exxon Valdez oil spill and the Enbridge Northern Gateway Pipeline project as case studies?	Petroleum (spill)	Mixed methods: case studies, document review, media accounts, field notes, interviews (n=35), and surveys (n=122)	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	An oil spill disrupted cultural ways of knowing, being, and living; the spill led to long-term and chronic (30 years at the time of the study) stress, distress, bitterness, feeling unsafe, and a sense of powerlessness; over time, this disruption impacted cultural ways of life and knowledge, especially the transfer of knowledge and skills to next generations; the prolonged litigation process that followed the spill also contributed to long-term and chronic stress
Europe (Finland and Sweden)						
Begum and Naskali (2016)[79]	Sámi (Finland and Sweden)	What are Sámi "experiences of the ongoing transformation of the region, livelihoods, the importance of traditional activities, changes in livelihood practices and the impact of those changes on their social lives"?[79]	Mining, climate change, and other industrial activities	Qualitative: interviews with Sámi Elders (n=9), community members (n=3), health-care professionals (n=1), and researchers (n=3)	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	Changes to the environment led to mental health impacts of depression; social impacts of tension among Sámi; and loss of cultural ways of knowing, being, and living—their identity
South America (Brazil, Chile, Guatemala, and Peru)						
Bruijn and Whiteman (2010)[99]	Machiguenga (southeastern Peru)	How do local Indigenous Peoples affected by the Camisea Gas Project reconcile "'glocal' identities with their traditional perspectives of self-determination and local cultural identity"?[99]	Petroleum	Qualitative: interviews (n=59), participant observations made by a researcher, ethnographic conversations, and document analysis	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	People experienced a loss of relationship with the land, reduced sense of cultural identity, and mental distress
Caxaj et al (2013)[81]	Mam-Maya residents, San Miguel Ixtahuacán (Baja Verapaz, Guatemala)	What influences did "Vancouver-based Goldcorp's operations [have] on the community health of Mam-Maya Indigenous residents of San Miguel Ixtahuacán, a municipality in the Western highlands of Guatemala in which 85% of Goldcorp's Marlin Mine is situated"?[81]	Mining	Qualitative: photovoice interviews (n=54)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	A mining company was linked to poverty, food insecurity, limited employment and educational opportunities, and fragile agricultural economies; these aspects led to emotional turmoil and other psychological impacts, leading to alcohol use and violence against women, including sexual violence and intimate partner violence
González-Parra and Simon (2008)[102]	Pehuenche community of Alto Bío Bío (Chile)	What are the "impacts generated by the construction of a hydroelectric dam on the social development, health, and culture of the Pehuenche Indians in Alto Bío Bío, Chile"?[102]	Hydroelectric dam	Qualitative: field notes	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	Forced relocation from a dam led to the loss of access to traditional ways of living, burial sites, ceremonies, and spirituality; community members felt vulnerable settling in a new area with different social networks; felt their abilities to self-determine were stripped; felt a loss of connection to the land, cultural roles, and identities; and felt resigned; these issues led to alcohol use, family violence, and family disintegration

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(Continued from previous page)						
Kelly (2019)[86]	Mapuche of Puelwillimapu Mapuche-Williche Territory (southern Chile)	"What are the impacts of small hydropower?; How are they conceived in Mapuche-Williche cosmovision?; and, How do they compare to those reported in the Environmental Assessment process?"[86]	Hydroelectric dam	Qualitative: participant observations made by a researcher and shared experiences, interviews (n=87), river transects (n=4), traditional meetings, map-making, document analysis, and workshops (n=8)	Indigenous stakeholders are named as team members, who are involved throughout the project in identifying research priorities and outcomes	The dam development caused spiritual concerns linked to water cycles, ancestors, land, and ceremonial spaces; a collective sense of loss and sorrow; stress associated with disappearing medicines as well as food and water insecurities, ceremonial practices, and future risks to the community's ways of knowing, being, and living; and fragmented relationships within the community
Werner (1985)[108]	Xokleng, Kaingang, and Guarani in Ibirama county (state of Sana Catarina, Brazil)	"How serious are the human problems caused by the construction of the Ibirama dam? How does the stress of the local people compare with stress elsewhere? And what exactly is most responsible for this stress?"[108]	Hydroelectric dam	Quantitative: surveys (n=111)	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	The uncertainty around the anticipated impacts from the dam development caused a lot of stress; stress levels were higher in women than in men; evidence suggested connections between psychosomatic and social stress; between stress levels and alcohol use, involvement in crime, and conflict; and between social stress and having less control and autonomy of their own affairs
USA						
Murray and Kroupa (2018)[104]	Mandan, Hidatsa, and Arikara Peoples in the Nishu area (Missouri River bottomlands)	How does the Nishu community socially construct "emic notions of belonging articulated with the spatial transformations resulting from twentieth-century assimilative policy in the United States"?[104]	Hydroelectric dam	Qualitative: oral history interviews (n=15)	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	Over time, the dam affected several Indigenous groups, leading to the loss of connections within families and communities, profound grief, and alienation between Indigenous groups that were connected by a shared relationship with the Missouri River; the long-term impacts from the loss of cultural identity and ways of life, feelings of alienation, and poor health outcomes led to depression, grief, and addiction
O'Sullivan and Handal (1988)[105]	Yavapai in Fort McDowell (central Arizona)	What are the psychological and medical effects of the threat of relocation for the Fort McDowell community due to the proposed construction of a dam?	Hydroelectric dam	Mixed methods: analysis of secondary data (n=154) and structured interviews (n=79)	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	The dam construction caused severe psychological distress that was reported as being more distressing than the death of close family members; the distress was linked to the impact of the dam on the land; the land's significance to the community's culture, identity, sense of home, and its government; and the threat of forced relocation
Palinkas et al (1993)[90] and Palinkas et al (1993)[91]	Alaska Native communities (Alaska)	What are the "changes in patterns of social relations, traditional subsistence activities, and the prevalence of physical and mental disorders since an oil spill event"[90] and what is the "relationship between exposure to the Exxon Valdez oil spill and subsequent cleanup efforts and the prevalence of generalized anxiety disorder, posttraumatic stress disorder (PTSD), and depressive symptoms in 13 Alaska communities"?[91]	Petroleum (spill)	Mixed methods: household surveys (n=594), interviews (n=unknown), and participant observations made by researchers	Indigenous stakeholders are informed by research teams about projects but are not invited to engage in any phase of the project	The oil spill was associated with mental health conditions of general anxiety disorder, post-traumatic stress disorder, and depression; 13 communities were affected by the spill and found that the spill greatly affected land-based and water-based traditional subsistence and ways of life (eg, hunting, fishing, harvesting, gathering, and teaching children about traditional knowledge and skills)

Table: **Descriptive overview of included studies**

31 records on 29 studies that met the inclusion criteria.[78–108] Studies were related to land dispossession due to hydroelectric dams (13 studies),[78,80,86,88,96,97,100–105,108] petroleum (12 records [11 studies]),[80,83–85,90–92,94,95,98,99,107] mining (ten records [nine studies]),[79–82,87,89,93,96,98,106] and agriculture (two studies; figure 2).[80,92] Six studies included more than one type of extractive industry.[79,80,92,96,98,106] Studies were done in Australia,[106] Brazil,[108] Canada,[78,80,82–85,87–89,92–98,100,101,103,107] Chile,[86,102] Finland,[79] Guatemala,[81] Peru,[99] Sweden,[79] and the USA.[84,90,91,104,105] 24 studies used qualitative designs,[78–81,83,85,86,88,89,92–104,106,107] six records (four studies) used mixed methods,[82,84,87,90,91,105] and one study was quantitative (table).[108] The studies excluded at the full-text screening stage and the reasons for exclusion are listed in appendix 2.

See Online for appendix 2

The studies varied in the extent and ways that Indigenous communities were involved in the research process. In 12 records (11 studies), researchers informed local communities about the study;[79,84,85,89–91,99,100,102,104,105,108] five studies included some form of consultation process;[83,98,101,103,106] nine studies involved Indigenous team members;[78,80,81,86,88,92,96,97,107] and five records (four studies) involved collaborations with Indigenous communities throughout the research process.[82,87,93–95] No study reported that Indigenous communities were equal partners in the research process. Based on the critical appraisal assessments, 11 records (ten studies) showed a clear connection between losing access to land and mental health,[78,80,90,91,93,97,100,101,104,105,108] whereas 16 studies showed somewhat clear connection,[79,81,83–86,88,89,92,94–96,98,102,106,107] and four records (three studies) showed weak connections.[82,87,99,103] Responses to critical appraisal questions in the modified CASP tool are reported in appendix 1 (pp 4–6).

Overall, the included studies showed that displacement and loss of land due to industrial resource development had negative impacts on the mental health of Indigenous Peoples. Observed mental health impacts included grief, sadness, and depression; stress and distress, anxiety, and fear; anger and frustration; feelings of hopelessness and powerlessness; substance use; and suicidal ideation. Synthesis of the results showed links between land dispossession, additional impacts related to industrial resource development, mental health, and long-term associations between social and mental health impacts (figure 3).

Land dispossession included permanent or temporary relocation of communities, landscape transformations due to construction, such as clearing forests or flooding, and contamination of land, water, and wildlife. Studies reported that local people were often unable to participate in subsistence activities such as hunting, fishing, and berry picking due to environmental changes related to industrial resource developments.[78–98]

In many cases, changes to the environment had immediate and negative effects on food security, traditional medicines and ceremony, and other daily practices. In a study on the perceptions of Nunatsiavut residents and the importance of traditional country foods, one participant noted: "Labrador Inuit tie themselves to the land; they see that they are a part of the land, so the food is part of who they are", while another person stated that country foods are "just what makes me who I am".[98] However, shared concerns surfaced over pipeline contamination of their land and the animals; a participant reported: "mussels stay in one place, too,

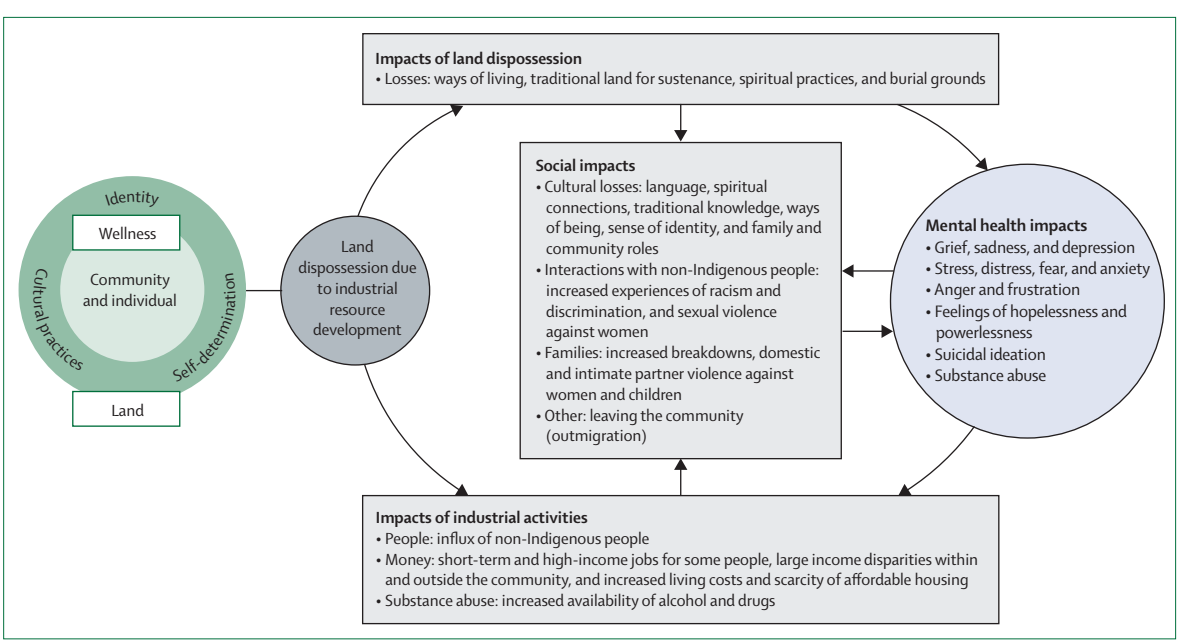

Figure 3: **The relationship between land dispossession due to industrial resource development and Indigenous Peoples' mental health**
Land is important to Indigenous Peoples and communities, in terms of identity, self-determination, and cultural practices. Mental health is affected initially by the impacts of land dispossession and industries, and over time by social impacts, which interact with, and exacerbate, negative mental health impacts.

and they get the oily taste from over there because the gas station and the oil are all over there".[98] In a study from Manitoba, Canada, a member of the Grand Rapids First Nation noted: "I can never remember ever being hungry before the dam, but after the dam we were hungry".[88] In a study about a pipeline spill in northern Alberta, Canada, a member of the Woodland Cree First Nation stated: "I love my traditional land, but people don't trust the animals – they taste funny – or the water here".[83] Additionally, residents distrust the industries in relation to the management of spills or leaks, with a member of the Aamjiwnaang First Nation in Ontario, Canada, stating: "if there is smell, the police will call around to industry to see who has reported a release…if no release has been reported, the community members are advised to either ignore the smell, or wait and see if any industry will report a release, which sometimes is days later when it is too late to take preventive actions".[107] Impacts on subsistence livelihoods were also linked to a loss of access to cultural practices,[79,84,86,89–91,93,96,99–101] and spiritual sites and practices.[84,89,90,92,96,102] In a study about land loss due to multiple forms of industrial resource development in northern Ontario, Canada, an Anishinaabe Elder reported: "There are some places that we can't go…[because of] the gates. Our forefathers never had gates. There is a place that's so important for our people. Our people used to go there and do ceremony. And now, any of you ever been there?"[96]

Studies reported that industrial resource development often severed relationships between Indigenous communities and their lands. An Innu Elder in Quebec, Canada, described this loss of connection as part of his mother's experience of hydroelectric development in their traditional territory: "Before the flood, it was a beautiful lake. My mother never wanted to go back and see her land after that, because it was changed completely. 'This is not my land', she used to say."[103]

Evidence suggested that industrial resource developments could negatively impact the mental health of community members via local economic changes, an influx of non-Indigenous people to communities, and an increased presence of substances such as alcohol and drugs within communities (figure 3). Short-term increases in salaries and jobs from industry-related employment (until the construction was done or the resources were extracted) created large income disparities, unevenly distributed work opportunities, and increased the cost of living.[78,81,82,87,90,91,102] In many cases, the influx of money and non-Indigenous people appeared to drive increases in drug and alcohol use, and associated social and mental health problems.[80,97,101] Overall, industry presence had a strong and varied influence on local socioeconomic conditions within and between communities. Such changes were often most evident during early phases of project development and are therefore considered initial impacts related to land dispossession.

Social impacts such as losses of cultural knowledge and practices emerged over time from the impacts of land dispossession and industry. Similarly, coping responses (eg, substance use) were linked to both mental health challenges and other social impacts—affecting individuals, families, and communities. Together, the evidence showed strong relationships between social impacts and ongoing cycles of trauma, dysfunction, and cultural loss, which led to substance use and moving away for some families (figure 3).

Social impacts included multiple dimensions of loss affecting language, spiritual connections, Indigenous knowledge systems, and related cultural practices.[82,84,86,87,89,92,96,98,101,103] In a study about the Trans Mountain Pipeline expansion in British Columbia, Canada, a member of Tsleil-Waututh Nation commented about loss related to water: "I think it is sad, you desperately want to connect with something that your people have connected to since the beginning of time. I call it blood memory…We have a reciprocal relationship [with water] as a living being…It [the contamination] is against our spiritual relationship with Mother Earth."[95]

Many studies found that declines in the use of Indigenous languages and participation in traditional activities corresponded with a loss of identity among community members.[79,84,90,91,95,97,99,102,104–106] In North Dakota, USA, the Arikara people experienced land dispossession from dam-related flooding. An Elder described the feeling of losing part of their identity when the land was flooded as: "When we came up on top [referring to the surface of the water], we left *everything* [emphasis his own] in the bottom".[104] By losing access to land that defined who they were, their way of life, and their local language, there was a profound sense of loss to their sense of purpose in life. Similarly, a member of the Yolngu people reflected on the impact of a mine in their territory, in Australia's northeast Arnhem Land, as going to the core of their strength as Yolngu people: "They are digging up the backbone of the Yolngu".[106]

Numerous studies observed relationships between a loss of connection to the land, substance use, and violence.[78,80–82,87–91,96,97,100–102,104] Studies also reported that many communities adjacent to major industrial projects experienced an influx of a primarily non-Indigenous fly-in fly-out mobile workforce. Participants in several qualitative studies observed that incidents of discrimination, racism, and violence were perpetrated by non-Indigenous workers.[78,87,88] Indigenous Peoples who were displaced and forced to relocate to larger towns and cities reported similar experiences of violence and exclusion.[78,83,101,103] Reflecting on the impacts of hydroelectric development, a municipal Councillor of Grand Rapids and a member of Misipawistik Cree Nation, who observed the dam construction since he was a child, commented: "I bet you we've seen more violence in those four years than most people will see in a lifetime. Violence in the community and violence between the workers…they were just harassing the local people."[88]

Several studies reported an increase in gender-based violence.[81,82,87,88] Indigenous women reported experiences of physical and sexual assault, and sexual harassment by industry workers,[81,82,87,102] as well as intimate partner violence.[90] In a study about Inuit women's experiences working at mines in Nunavut, Canada, a participant shared: "The names that women are being called and the expectations…The women are afraid to take it to the human rights [reporting a violation to the Canadian Human Rights Act] because they're going to lose their jobs, and that's a pretty powerful obstacle. But it's true, yeah, I believe that sexual assault is happening as a matter of fact up at the mines…We've had a number of women coming in and telling us about rapes."[87]

Another social impact evidence in included studies was outmigration. People from communities close to a project site often moved elsewhere for employment, a lower cost of living, or to escape violence.[79–81,84,88,90,93,94,100,103,105] One of the most widely noted social outcomes was the breakdown of family and community bonds.[78–83,86–90,92,100–102,104,106] In sum, communities experiencing land dispossession due to extractive industrial activity faced multiple negative impacts on culture and social cohesion.

In addition to magnifying social risks for poor mental health, studies showed that mental health in Indigenous communities has been directly impacted by land dispossession due to industrial resource development. In the face of development decisions over which communities had little control, many study participants reported a range of negative emotions (figure 3). Anger and frustration were associated with feeling dismissed, disregarded, or betrayed by companies or government,[83,85,88] and at other times, in response to people's uncertainty about the future of their lands and traditional activities.[79,93,107] These reactions were intertwined with feelings of hopelessness[79,88,102] and powerlessness.[80,84,86]

Several studies directly linked grief, sadness, and depression to the initial loss of access to the land, and the resulting prohibitions on land-based activities such as hunting, fishing, and ceremonies that were important for identity, Indigenous knowledge, and cultural practices.[80,83,86,92–96,101,104,107] Anishinaabe Elders who experienced long-term displacement due to flooding in Manitoba, Canada, used the term *maziaya* to describe their "profound grief related to multiple losses".[78] In several studies, participants described feeling despair[80] and devastation[83] in response to land loss. An Anishinaabe Elder explained the impacts of land loss due to mining and forestry development in northern Ontario, Canada: "We are the land. If the land is sick then it ain't going to be very long before we're going to get sick."[96]

Four studies described affective responses to dispossession with the term solastalgia.[83,85,95,103] Solastalgia is the psychological experience of desolation and distress caused by changes in the environment and spaces that people associate with solace, comfort, and home.[109] In the context of land loss due to petrochemical-related contamination in southwestern Ontario, Canada, an ethnographic study showed that the Aamjiwnaang First Nation experienced a kind of trauma associated with dislocation from place. They described it as: "dysplacement—that is, a profound feeling of disorientation toward ancestral land".[85] Yolngu participants in a study of northeast Arnhem Land, Australia, spoke of how the changing landscape from mining, further exacerbated by climate change, negatively impacted their physical and mental health, saying: "We'll become dimmer and dimmer like a candle".[106]

We identified two studies that used standardised quantitative measures to assess mental health impacts in Indigenous communities that experienced land dispossession due to industrial resource development.[90,105] One study investigated the psychological effect of a hydroelectric dam construction on community members in the Fort McDowell Yavapai Nation in Arizona, USA.[105] The results indicated that 22% of participants experienced levels of distress equivalent to patients with diagnosed mental illnesses, with a large majority of community members scoring the dam construction as: "more upsetting to them and as having more deleterious effects on their tribe as a people and culture…than the most distressing life events they had ever experienced".[105] Another study examined the relationship between the Exxon Valdez oil spill and symptoms of anxiety, post-traumatic stress, and depression among Indigenous communities in Alaska, USA.[90] The results indicated that exposure to the spill and subsequent clean-up was significantly associated with the higher scores on standardised scales that measured anxiety, post-traumatic stress disorder, and depressive symptoms.[90]

Discussion

Our findings show complex relationships between land dispossession related to industrial resource development and the mental health of Indigenous Peoples. There were no clear links between specific industries and the types and extent of mental health impacts on Indigenous communities. Rather, there were marked similarities across industries and geographical contexts. Overall, studies showed that Indigenous Peoples experienced negative mental health impacts after land dispossession due to the development of industrial resource extraction projects on Indigenous lands, regardless of how geographically close they were to the industrial site.

Our results align with previous reviews that found industry workers and surrounding communities experience disproportionate and negative health consequences related to resource extraction industries.[34,58,110] These consequences include physical health impacts (eg, respiratory issues, cancer, poisoning or blood disorders, acute and chronic injuries, and chronic and infectious diseases) related to occupational hazards of working directly with coal, oil, gas, and metals, as well as downstream contamination of soil, water, and air.[110–113] Globally, involuntary displacement related to mining,

hydroelectric, or petroleum projects, and resettlement of people, both Indigenous and non-Indigenous, have contributed to increased unemployment, homelessness, food insecurity, and the breakdown of social organisation in many communities.[108,114–120] Once industrial projects are approved, the increased in-migration of mobile workforces and the forced relocation of Indigenous Peoples to areas with predominantly non-Indigenous populations can lead to increased reports of racism and discrimination, and a rise in poverty due to higher costs of living. Gendered violence against women and girls who work in, or live near, project sites has been reported in numerous studies across multiple industries,[121–126] but most commonly in the mining industry.[122,127–129]

This systematic review affirmed the foundational roles of land and relationships to the environment as determinants of mental health for Indigenous Peoples. Studies consistently showed that experiences of land loss due to industrial resource development had negative impacts on mental health, through threats to language, cultural identity, relationships, and self-determination.[3,12,13,130,131] Similarly, forced relocation of Indigenous families and communities in the USA and Canada had indirect but clear links to elevated risks for depression and substance use across multiple generations.[132]

The associations between industrial resource extraction and mental health parallel the findings of studies about the mental health impacts of climate change.[133–135] Climate change alters the physical environment and Indigenous Peoples' relationship to it, and has direct and indirect impacts on land-based activities, food security, Indigenous Peoples' knowledge systems, infrastructure, and cultural continuity.[136–138] Increasingly, evidence has shown that climate change also has consequences for mental health, including elevated suicidal ideation, stress, substance use, and symptoms of depression and anxiety.[108,133,134]

Despite the growing recognition of the rights of Indigenous Peoples, communities have had varied experiences with, and relative influence on, decision making in industrial resource development. For example, in Canada, when industries are required to complete project-based environmental, social, and health impact assessments before developments start, Indigenous Peoples' concerns expressed during consultations are often not addressed or taken seriously.[139–142] Moreover, health impact assessments might not integrate mental health or other locally relevant determinants of health—eg, recognising how historical and contemporary forms of colonialism and governance are inherently linked to health outcomes or including local Indigenous knowledge systems that consider how non-human systems are inseparable from human health.[143–146] When industries are approved, health monitoring and integration of Indigenous resource governance are crucial to ensuring the sustained recognition and respect for Indigenous Peoples' rights and mitigation of development impacts.[147]

Although our findings indicate that land loss contributes to negative mental health impacts, dispossession also thwarts opportunities for promoting mental health and wellness. Land-based and place-based health and healing initiatives addressing the traumas of colonisation have been shown to improve Indigenous Peoples' mental and physical health.[1,2,4,6,63] Land-based and place-based programmes are a way to restore community-specific ways of knowing, being, and doing—in the very places where Indigenous groups lived, thrived, were healthy, felt a sense of belonging, and knew a clear sense of purpose.[6,13,33] In areas where industries have irreconcilably altered or contaminated the land, the possibility of land-based and place-based healing is diminished.

Although this Review risks replicating deficit-based narratives about Indigenous Peoples,[148] examples exist of Indigenous resistance to, and successful negotiations in, industrial resource development.[47] In 2022, courts in Ecuador ruled that Indigenous communities "must not only be consulted about extractive project on or near their territory, [but] they must also give their consent to such projects".[149] Until governments and industries are required to adhere to practices that honour Indigenous Peoples' rights to free, prior, and informed consent, the negative mental health impacts from industrial resource development will probably persist with reduced efforts to prevent or mitigate them.[147,150–153]

This systematic review had several limitations. First, eligibility was restricted to studies in English set in the Circumpolar North, North and South America, Australia, and Aotearoa. Although the search strategy was comprehensive, it did not include studies from low-income and middle-income countries in Africa and Asia, where the majority of Indigenous Peoples live globally. Additionally, because of the intensification of large-scale developments in Indigenous territories in South America, this Review missed studies published in Spanish or Portuguese. The focus on specific industries also meant that research related to forestry, manufacturing, or other industries was not captured.

Second, for some included studies, it was difficult to disentangle the relationships between mental health and land dispossession from mental health risks related to social impacts. This issue partly arose because the majority of research used qualitative methods that elicited descriptions of overlapping and multifaceted relationships between factors. Relatedly, quantitative evidence was scarce, and the included studies were of low quality. We identified only one eligible epidemiological study in this Review. Future studies should address the gap in epidemiological evidence to help discern specific associations between land dispossession and mental health, recognising that many Indigenous communities do not have access to effective mental health services.[154,155]

Finally, although the majority of included studies reported negative consequences for mental health in Indigenous communities, it is unclear whether negative

consequences are a universal experience, or whether positive effects on mental health are not captured in research. Relatedly, the scope of evidence is disproportionately small compared with the intensity and economic valuation of industrial resource development, which means that the full extent of mental health impacts remains unexamined. Power asymmetries between Indigenous communities and the multinational corporations and governments that initiate extractive developments tend to silence, under-report, and subvert Indigenous People's voices, experiences, and rights. A scarcity of empirical evidence on the health impacts, including mental health, from industrial resource developments on Indigenous communities could be tied, in part, to corporate and government interests.[156,157] Even in contexts where communities experience benefits and possible positive impacts,[158,159] mental health is rarely examined. These limitations were partly offset by our rigorous search of the grey literature, which did not result in any additional evidence of positive mental health impacts.

Conclusions

This Review examined the state of the evidence on Indigenous Peoples' mental health in relation to four major resource industries within settler colonial states. Included studies focused on Indigenous communities that experienced land dispossession due to mining, hydroelectric, petroleum, and agricultural developments. Evidence showed that land is central to Indigenous Peoples' mental health, and that land dispossession related to industrial resource development had negative mental health impacts on Indigenous communities. Evidence also showed that literature reporting on the mental health impacts associated with industrial resource developments is scarce. More community-driven research, by and with Indigenous Peoples, is needed to further investigate the relationships between industrial resource development and Indigenous Peoples' mental health. Health impact assessment processes related to industrial resource development must include and respect the rights of Indigenous communities and consider risks and outcomes related to mental health.

Contributors

MEMN, NJP, JL, and AK contributed to the methodology. MEMN and NB contributed to data curation. MEMN, NB, NTGG, JM, and AL contributed to the formal analysis. MEMN was responsible for funding acquisition. MEMN, NB, NJP, NTGG, JM, JL, JRR, LJB, and AL contributed to document screening and data extraction. MEMN and NB were responsible for project administration. MEMN supervised the work. MEMN, NB, NJP, NTGG, AK, and AL designed the figures. MEMN, NB, NJP, NTGG, JL, AK, and AL wrote the manuscript. All authors reviewed and edited the manuscript.

Declaration of interests

MEMN was contracted by West Moberly First Nations to do the systematic review. MEMN is the Tier 2 Canada Research Chair in Community-Driven Knowledge Mobilization and Pathways to Wellness, Canada. NB, NJP, NTGG, JM, JRR, and LJB were hired by MEMN on a contract basis through this funding. All other authors declare no competing interests.

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