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Fright factors about wind turbines and health in Ontario newspapers before and after the Green Energy Act

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In this article, we analyse coverage of the health effects of wind turbines in Ontario newspapers relative to the Green Energy Act using published risk communication fright factors. Our aim was to provide insights into the health risk information presented in newspapers serving Ontario communities where wind turbines are located. We selected five geographically discontinuous wind energy installations in Ontario and their surrounding communities based on 2006 Canadian Census data. We identified the newspapers serving each community and searched for articles from May 2007 to April 2011 on wind turbine technology and human health, identifying a total of 421 articles from 13 community and 4 national/provincial newspapers. We found that most newspaper articles included the fright factor of 'dread' (94%) and well over half (58%) included the fright factor of 'poorly understood by science'. 'Involuntary exposure' and 'inequitable distribution' were fright factors occurring in somewhat fewer than half of the newspaper articles (45% and 42%, respectively). Of note was that four of the fright factors – 'dread', 'poorly understood by science', 'inequitable distribution' and 'inescapable exposure' – occurred more frequently in community newspaper articles than in national/provincial ones ($p < 0.001$). Although the total number of occurrences of each fright factor increased following the Green Energy Act, only 'dread' ($p < 0.05$) and 'poorly understood by science' ($p < 0.01$) increased significantly. We conclude that Ontario newspapers contain fright factors in articles about wind turbines and health that may produce fear, concern and anxiety for readers.

Keywords: risk communication; public health; mass media; wind turbines

Introduction

The Government of Ontario, Canada has established goals for reducing greenhouse gas emissions through the Climate Change Action Plan (MOE 2010). Part of this plan involves phasing out coal-fired power plants and supporting renewable energy technologies, such as wind, solar, hydro, biomass and biogas. The objective of this programme is to double the amount of electricity from renewable sources by 2025, positioning Ontario as one of the top energy producers in North America. By implementing the Green Energy Act in 2009, the province streamlined the approval process for many renewable energy technologies, notably wind energy installations. As a result, the number of wind turbines in Ontario increased from 10 in 2003 to almost 700 currently in place or planned (MOE 2010). The rapid and substantial increase in the number of wind turbines has caused concerns among individuals and community organisations, in part due to potential health effects.

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The health impact of wind energy installations has become a widely debated political issue in Canada (Knopper and Ollson 2011, Watson *et al.* 2012) and elsewhere (Pedersen 2011). In 2010, the Ontario Chief Medical Officer of Health concluded that the current scientific literature does not demonstrate a causal link between exposure and direct health effects (CMOH 2010). However, there are anecdotal reports which indicate a possible relationship between exposure and health effects such as dizziness, headaches and sleep disturbance (Pierpont 2009, Knopper and Ollson 2011). People living near wind turbines have reported prolonged annoyance and psychosocial stress, which may physically manifest as adverse health effects (Pedersen and Waye 2004). Media triggers, including conflicting opinions, high exposure and human interest through identification of victims, have made the potential public health risk of wind turbines a newsworthy story (Bennett 2010).

The public often gathers information relating to health consequences of environmental exposures from news reports, rather than more science-based sources such as health care practitioners (Lundgren and McMakin 2009, Riesch and Spiegelhalter 2011). However, many newspaper editors consider stories for publication in terms of economic, political or cultural relevance rather providing information about public health (Hillier 2006, McCarthy *et al.* 2008). Public perceptions of health risk can be influenced by the way the media frames and covers a risk story, especially how and what elements are reported (Rowe *et al.* 2000). Several factors including message content, tone of delivery, expert sources and information accuracy influence whether the public attends to, understands and acts on risk information (McCarthy *et al*. 2008). A diagnostic checklist of fright factors has helped to explain why some environmental health risks are more likely to trigger alarm, anxiety or outrage than others, independently of scientific estimates of their seriousness (Bennett 1999). Media stories that contain a large number of these fright factors provoke a strong public reaction (Bennett 2010). These fright factors have been shown in newspaper coverage of human papillomavirus (HPV) vaccination, avian flu, biosolids and genetically modified crops (Burke 2004, Goodman and Goodman 2006, Abdelmutti and Hoffman-Goetz 2009, Fung *et al.* 2011).

In the present study, we analysed newspaper coverage of the health effects of wind turbines in Ontario newspapers using a published typology of fright factors (Bennett 1999). Our aim was to provide insights into the public newspaper discourse about health risks from exposure to wind turbines using select Ontario communities. We chose Ontario, Canada as a case study because of recent major policy legislation on alternative energies, including wind turbines, known as the Green Energy Act. We did not evaluate the biological evidence for or against health effects of wind turbines but rather the occurrence of fright factors linked to possible health effects of wind installations.

Methods

We identified 37 wind turbine installations prior to September 2011 in Ontario using the CANWEA database (CANWEA 2011). From this list, three large and two small wind energy installations, which began operation between 2006 and 2009, were selected: large installations were Melanchton Phase II, Ontario Wind Power Farm and Prince Wind Farm with 88, 110 and 126 turbines, respectively; small installations were Dunnville Wind Turbine and Proof Line Wind Turbine with one and four turbines, respectively. We selected these turbines because they were geographically discrete, represented a diverse set of communities in Ontario and reflected differing magnitudes of installations throughout the province. Maps identifying the location of each of these wind energy

developments can be found on the CANWEA database (http://www.canwea.ca/farms/index_e.php). We generated a list of communities within a 50 km radius of each installation using 2006 Canadian Census subdivisions maps. In addition, large urban centres (Toronto and Hamilton), which were located just beyond the 50 km radius, were included because of their potentially high influence on the public agenda about wind turbines and health. The approximate population of census subdivisions for Melancthon Phase II was 2,600,000 (including Toronto), for Ontario Wind Power Farm was 85,000, for Prince Wind Farm was 95,000, for Dunnville Wind Turbine was 750,000 (including Hamilton) and for Proof Line Wind Farm was 460,000. We identified the newspapers distributed in each census subdivision through the Canadian Newspaper Association database (CCNA 2011). Seventeen newspapers were included, with four considered national/provincial and thirteen considered community based on geographic reach, circulation size and frequency of publication (Table 1). The four national/provincial newspapers included the *Globe and Mail*, *National Post*, *Toronto Star* and *Hamilton Spectator*. The *Globe and Mail* and *National Post* are generally considered to be national newspaper sources because several editions are published across Canada. However, we used only 'Ontario' editions for this study. The *Toronto Star* and *Hamilton Spectator* are considered provincial newspapers, with the majority of their readership based in Toronto and Hamilton, respectively, and the remainder spread throughout neighbouring major cities.

Newspapers were searched using the LexisNexis database and individual newspaper websites from May 2007 to April 2011 (2 years before to approximately 2 years after the introduction of the Green Energy Act in May 2009). The following search terms alone and in combination were used to identify articles: (wind turbine* or wind farm* or wind energy or wind power or windmill* or green energy or renewable energy or turbine* or alternative power) and (health* or noise or vibration* or stress* or sleep* or flicker* or mood* or illness* or mental* or joint pain). Articles were excluded if they were duplicates, outside of date range, did not contain the terms 'health' and 'wind turbine' or 'wind farm' or contained 'health' not related to humans (such as economic health).

We undertook a directed content analysis to develop the coding instrument based on the fright factors that affect the public's perception of risk (Hsieh and Shannon 2005). This approach is guided by a structured process in which existing theory is used to identify key concepts or variables as coding categories. We developed operational definitions for each of the fright factors used in this study, and examples of their application to newspaper articles on wind turbines and health can be found in Table 2. We also coded articles by newspaper name, newspaper type (national/provincial, local), article date, article type (article, letter to editor, editorial/column), article main focus (human health, other) and number of references to health. We classified the main focus of an article as 'human health' if the article made a reference to health three or more times and as 'other' if human health was mentioned fewer than three times in the article. The 'other' category included topics such as the economy, politics and the environment.

One author coded all of the articles. However, to ensure reliability of data extraction, a randomly selected subset of 100 articles was coded by two independent readers, and inter-rater reliability was calculated. Cohen's kappa ranged from 0.813 to 1.00, with an average of 0.920, indicating excellent agreement for each variable. The readers/coders resolved discrepancies through discussions which informed the coding process.

We generated descriptive statistics (frequencies, means and percentages) on the fright factors mentioned in the articles (SPSS v20, SPSS Inc., Chicago, IL) and analysed differences in the frequency of fright factors across newspaper type and relative to the Green Energy Act using chi-square. We used Student's *t*-test to analyse the number of

Table 1. Summary of newspapers included in study.

Newspaper name	Category	Geographical distribution (census subdivisions)	Circulation size (Canadian Newspaper Association annual circulation for 2010)
Globe and Mail	National/ provincial	All	317,781 (daily)
Toronto Star	National/ provincial	All	292,003 (daily)
National Post	National/ provincial	All	158,250 (daily)
Hamilton Spectator	National/ provincial	All	91,716 (daily)
Orangeville Banner	Community	Melancthon, Shelburne, Southgate, Orangeville, Grey Highlands, Amaranth, Mulmur, Caledon	42,508 (twice weekly)
Orangeville Citizen	Community	Melancthon, Shelburne, Southgate, Orangeville, Grey Highlands, Amaranth, Mulmur, Caledon	14,412 (weekly)
Hanover Post	Community	Hanover, Brockton	14,868 (weekly)
Kincardine News	Community	Kincardine	2,838 (weekly)
Lucknow Sentinel	Community	Huron-Kinloss	1,412 (weekly)
The Owen Sound Sun Times	Community	Owen Sound	12,505 (daily)
Shoreline Beacon	Community	Arran-Elderslie, Saugeen Shores	3,765 (weekly)
Lakeshore Advance	Community	Lambton Shores, South Huron, North Middlesex	1,254 (weekly)
Sault Star	Community	Prince, Sault Ste. Marie, Rankin 15D, Garden River 14, Elliot Lake, Algoma	13,851 (daily)
Londoner	Community	London	145,200 (weekly)
Sarnia Observer	Community	Sarnia, Plympton-Wyoming	13,029 (daily)
Sarnia and Lambton This Week	Community	Sarnia, Plympton-Wyoming	39,296 (weekly)
St. Catharines Standard	Community	St. Catharines	19,388 (daily)

Table 2. Diagnostic fright factors and application to wind turbine news media.

Fright factors (Bennett 1999, 2010)	Examples of application to wind turbine media coverage
Involuntary exposure	Location of wind turbine not under influence of community or nearby residents
Inequitably distributed	Wind turbines present in certain communities and absent in others
Inescapable by taking personal precautions	Unable to avoid vibration/noise/flicker unless physically distant from wind turbine
Cause hidden or irreversible damage	Some effects of low frequency vibration and noise (such as infrasound) cannot be seen or heard
Pose particular danger to small children or pregnant women	Potential effect of wind turbines on learning and behaviour of children, long-term fertility unknown
Arousing dread due to death, illness or injury	Threat of long-term illness unknown. Chronic migraines may increase risk of other health problems
Damage to identifiable victims	Specific cases of residents leaving homes within close proximity to turbine
Poorly understood by science	Lack of studies on health effects relating to wind turbine exposure
Subject to contradictory statements from responsible sources	Municipal governments/councils conflict with provincial governments (such as moratoriums)
Arises from unfamiliar or novel source	Not applicable
Result from man-made sources	Not applicable

mentions of health in each article by newspaper type and accepted. A p-value of <0.05 indicated that differences were not the product of chance.

We used a cluster analysis (SAS v9.2, SAS Institute Inc., Cary, NC) to identify distinct community subgroups based on demographic variables from the 2006 Canadian Census; these variables were population density, population with post-secondary education, house value and median income, which broadly reflected 'urban' and 'rural' community characteristics. The cluster technique groups communities that share similar socioeconomic and demographic characteristics. Classifying communities into various subgroups allowed us to determine whether the content of newspaper articles on wind turbines and health varied based on characteristics of the readership.

Findings

Coverage by newspaper and region

There were 421 newspaper articles retrieved from 17 newspapers. Of these, 150 articles were from 4 national/provincial newspapers and 271 articles were from 13 community newspapers. The number of newspaper articles about wind turbines and health published from each newspaper type increased substantially over time. In the national/provincial newspapers for full years of coverage, the number of articles were 13 in 2008, 52 in 2009 and 40 in 2010 ($X^2 = 22.8$, df = 2, $p < 0.001$). Also of note is that for the 4 months of data collection in 2011 (January–April), there were 34 articles on wind turbines and health appearing in the national/provincial newspapers. In the local newspapers, the number of articles on wind turbines and health also increased: 15 in 2008, 90 in 2009 and 107 in 2010 ($X^2 = 67.83$, df = 2, $p < 0.001$). For the 4-month period of January–April 2011, there were 49 articles on wind turbines and health in the local newspapers. The increase in newspaper articles over time was greater in community newspapers compared to national/provincial newspapers ($X^2 = 9.63$, df = 4, $p < 0.05$).

There were differences in news coverage based on wind energy development size. The small wind energy developments included in this study, Dunnville and Proof Line, accounted for 15% ($n = 42$) of the community newspaper coverage collected on wind turbines and health. The large wind energy developments, in contrast, contributed 85% ($n = 229$) of the community newspaper coverage on wind turbines and health.

Prevalence of fright factors

The most common fright factors linking wind turbine exposure to human health were 'dread', 'poorly understood by science', 'involuntary exposure' and 'inequitable distribution' occurring in 94% ($n = 394$), 58% ($n = 242$), 45% ($n = 188$) and 42% ($n = 177$) of articles, respectively. In the following extracts, we present illustrative examples of newspaper coverage highlighting the four most prominent fright factors.

Dread

We identified the fright factor 'dread' as a negative, loaded or fear-evoking description of health-related signs, symptoms or adverse effects of wind turbine exposure.

> Extract from *Lucknow Sentinel* (community newspaper), May 2009: In a recent interview…all made it clear that the [family's] environments had two changes occur simultaneously in November of 2007 [when the Ripley industrial wind turbine project was installed]. First there

was a change in the hydro configuration to their homes enabling electrical pollution to enter via a cross contamination from the wind turbine high voltage collection lines. The second change was the repetitive sound, both low frequency and audible from the blades of the industrial turbines that began rotating close to and above the height of their homes. Since these two changes, all began experiencing sleep deprivation, humming in the head and ears, stress, anxiety, heart palpitations, increased blood pressure, vibrations in the chest, earaches, headaches, an increased sensitivity to noise and sore eyes. It gets worse when the winds increase.

Extract from *Hanover Post* (community newspaper), Jan 2011: Stelling's comments, and a two-page letter he read to council outlining results of studies about adverse health issues resulting from the low frequency noise emitted by the turbines and suggestions that turbines have setbacks from 1 to 4.3 km from any residences, drew loud applause from those in attendance.

Poorly understood by science

We identified the fright factor 'poorly understood by science' as the need for a health study, the unknown effects or outcomes on health or the implementation of a moratorium until health effects are better studied.

Extract from *Sarnia & Lambton County this Week* (community newspaper), Oct 2008: The residents, 180 of [whom] signed a petition presented to council, are hoping the municipality will do a health study before making a decision about the project.

Extract from *Lucknow Sentinel* (community newspaper), Feb 2011: 'We haven't had the opportunity to do a lot of scientific research around the large-scale, very large-sized turbines that are generally the type most projects are installing,' Gillespie said.

Involuntary exposure

We operationalised the fright factor 'involuntary exposure' as a stated or implied statement that wind turbine placement was beyond the control of an individual or municipality, or that the Green Energy Act removed municipal rights over land development:

Extract from *Lakeshore Advance* (community newspaper), March 2009: They are just being whipped into place without due diligence, and now our Premier has decided to take out the role of the municipalities. Instead of working with them to solve issues, he is rolling over them.

Extract from *Kincardine News* (community newspaper), Aug 2010: The lakeshore community of Point Clark does not want to see this project move forward, but instead of the company demonstrating why it should be allowed to build, or recommending where the best place would be, the decisions have already been made and the public's opinion isn't a factor in determining where the turbines are erected, at all.

Inequitable distribution

We judged that the fright factor 'inequitable distribution' was present if the newspaper article mentioned (directly or indirectly) the risk of health effects from wind turbines increased with proximity or was higher in one group compared to another.

Extract from *Kincardine News* (community newspaper), Aug 2010: In the Ripley area, Lynn said 10%, or about 35 people living within the wind development area, have said they suffer as a result of proximity to the turbines.

Extract from *Lakeshore Advance* (community newspaper), Sept 2010: During a question-and-answer period, McMurtry agreed with one participant's assertion the projects are going

up in rural Ontario, because urban residents are supporting the Green Energy Act without understanding its long-term impacts. 'Make no mistake about it. This is a targeting of rural Ontario.'

The other five fright factors occurred less frequently in the newspaper articles: 'identifiable victims' in 19% of articles (n = 80), 'inescapable' in 15% of articles (n = 64), 'contradictory statements from reliable sources' in 9% of articles (n = 39), 'damage to future generations' in 6% of articles (n = 23) and 'hidden or irreversible damage' in 3% of articles (n = 12). In the following extracts, we present illustrative examples newspaper coverage highlighting these less common fright factors linking wind turbines and human health.

Identifiable victims

We identified the fright factor 'identifiable victims' as occurring in newspaper articles if there was a reference to a named individual who was affected by wind turbines.

Extract from *Kincardine News* (community newspaper), April 2009: 'I consider myself a green person, but there's controversy on how green (wind turbines) actually are,' said Norma Schmidt of Bruce Twp. who lives west of Underwood and came to protest because of the perceived health impacts it has had on her and her family. With wind turbines erected around her property, she and her husband Ron have experienced sleeping problems and headaches since the commissioning of the project.

Extract from *the Owen Sound Sun Times* (community newspaper), July 2009: 'We can't live in our house anymore. We bought a house and moved to Kincardine. My son and daughter-in-law and two-year-old who live on a different farm... the wind company is paying for them to stay in Kincardine,' said Glen Wild, one of a half-dozen speakers at a public information session on the dangers of living too close to wind turbines.

Inescapable

We identified the fright factor 'inescapable' if a newspaper article stated that an individual or family was unable to modify their exposure to the health risk or were forced to leave their home.

Extract from the *Londoner* (community newspaper), Dec 2010: As more wind farms are built, more stories are emerging of farmers having to leave their homes because of health issues attributed to wind turbines.

Extract from *Toronto Star* (national/provincial newspaper), Jan 2011: Too many Ontario families have already been made ill and forced to flee from their homes as a result of hastily developed wind energy projects with inadequate setbacks.

Contradictory statements

We identified the fright factor 'contradictory statements' as occurring in newspaper articles which emphasised that experts (such as medical health officers and government officials) were on opposite sides of the issue.

Extract from *Globe and Mail* (national/provincial newspaper), Jan 2011: To support his client's case in court, Mr. Gillespie will present evidence from three physicians who say turbine noise and vibration can cause high stress, sleep deprivation and headaches among people who live near them. The government argues, in a document filed with the court, that

the doctors' conclusions are suspect, and that it reviewed all the literature available on the issue, and held public consultations before creating the guidelines.

Extract from *Toronto Star* (national/provincial newspaper), Jan 2011: Their case was bolstered last May after the provincial medical officer of health, Dr. Arlene King, issued a report saying no scientific evidence exists to show that wind turbines harm human health. (Dr.) McMurtry countered that this is because no one has ever conducted a proper study - which is why he wants one.

Damage to future generations

Newspaper articles that contained the fright factor 'damage to future generations' had statements which identified the health of pregnant women, infants, children or teenagers as being adversely influenced by wind turbine exposure.

Extract from *Lucknow Sentinel* (community newspaper), May 2009: 'We have taken three-year-old Keiara to the emergency room 10 times with problems and Dr. McMurtry said my daughter shouldn't be there (at their home in the Ripley Wind Project). Melissa as well because she is pregnant,' said Kent Wylds.

Extract from *Toronto Star* (national/provincial newspaper), April 2010: They claim the turbines cause low-frequency noise and have sickened 106 Ontario residents, causing a variety of health ailments ranging from hypertension to sleeplessness and nosebleeds in children.

Hidden or irreversible damage

We recognised the fright factor 'hidden or irreversible damage' as being present in newspaper articles which stated that individuals did not know the source of their symptoms or that exposure to wind turbines may result in lasting health effects.

Extract from *Lucknow Sentinel* (community newspaper), June 2009: Krogh compared the situation to discovering the harmful effects of tobacco adding that there is no long-term investigation into the effects of wind turbines in 10 to 20 years.

Extract from *Kincardine News* (community newspaper), Feb 2011: Remember thalidomide and second-hand smoke, both perceived as acceptable at one time until science proved otherwise. Unfortunately this approach is being taken again with the blind acceptance of wind farms in close proximity to humans.

The fright factors of 'dread', 'poorly understood by science', 'inequitable distribution' and 'inescapable' occurred more frequently in community newspapers than in national/provincial ones ($X^2 = 12.11$, df = 1, $p < 0.001$; $X^2 = 36.19$, df = 1, $p < 0.001$; $X^2 = 15.45$, df = 1, $p < 0.001$; $X^2 = 17.61$, df = 1, $p < 0.001$, respectively). National/provincial and community differences in the occurrence of the four most common fright factors are shown in Figure 1. The remaining, less prevalent fright factors are shown in Figure 2. Article focus (human health vs. other) differed between newspapers, with community newspapers focused more on human health than national/provincial newspapers ($X^2 = 36.193$, df = 1, $p < 0.001$). There was an average of 5.01 ± 3.9 (SD) mentions of health per article from community newspapers and 2.53 ± 2.4 (SD) mentions per article from national/provincial newspapers ($t = 8.0$, df = 416, $p < 0.001$).

Influence of the Green Energy Act

The number of occurrences of each fright factor increased after the Green Energy Act, with dread and poorly understood by science increasing significantly ($X^2 = 4.76$, df = 1,

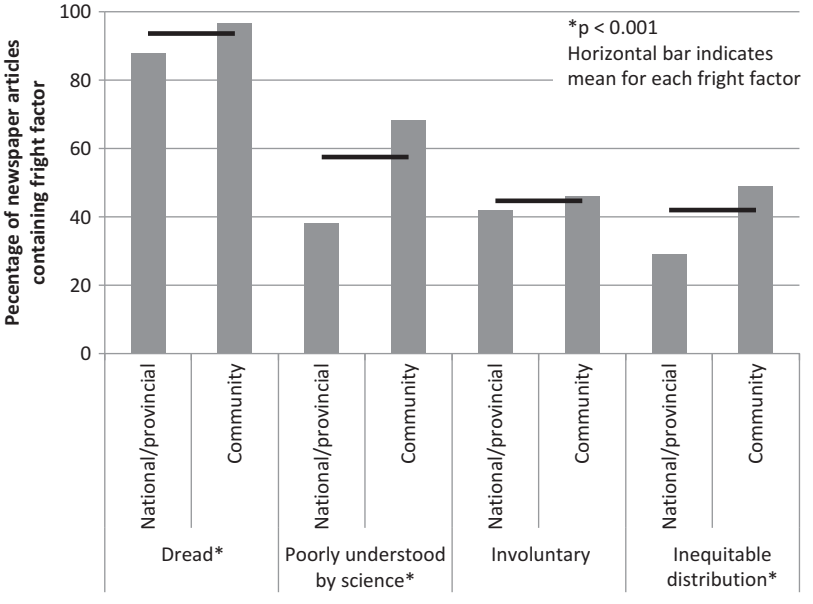

Figure 1. Presence of most commonly mentioned fright factors in Ontario newspaper articles.

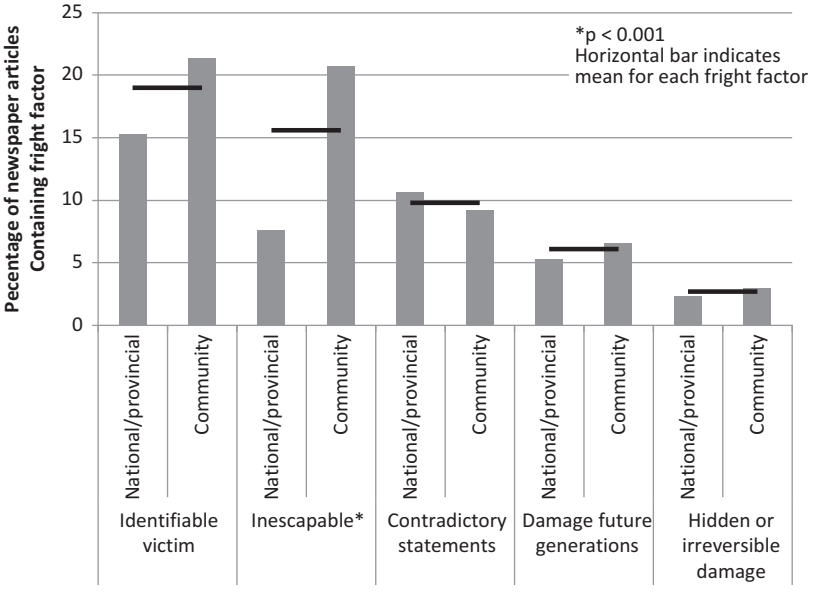

Figure 2. Presence of less commonly mentioned fright factors in Ontario newspapers articles.

$p < 0.05$ and $X^2 = 7.66$, df = 1, $p < 0.01$, respectively). The fright factor identifiable victims occurred less often after the Green Energy Act ($X^2 = 25.35$, df = 1, $p < 0.001$) (Table 3). Both community and national/provincial newspapers were more likely to focus on human health following compared to before the Green Energy Act ($X^2 = 19.36$, df = 1, $p < 0.001$).

Table 3. Presence of fright factors before vs. after the Green Energy Act in Ontario.

	Before Green Energy Act (total number of articles = 99)		Following Green Energy Act (Total number of articles = 322)			
Fright factor	Number of articles with fright factor	Percentage of articles with fright factor	Number of articles with fright factor	Percentage of articles with fright factor	Chi-square	*p*-value
Arousing dread	88	88.9	306	95.0	4.759	0.029
Poorly understood by science	45	45.5	197	61.2	7.662	0.006
Involuntary exposure	46	46.5	142	44.1	0.171	0.679
Inequitable distribution	38	38.4	139	43.2	0.711	0.399
Identifiable victim	36	36.4	44	13.7	25.348	0.001
Inescapable	14	14.1	50	15.5	0.113	0.737
Contradictory statements	8	8.1	31	9.6	0.215	0.643
Damage to future generations	8	8.1	15	4.7	1.717	0.190
Hidden or irreversible damage	2	2.0	10	3.1	0.322	0.570

Cluster analysis

To explore whether community characteristics influenced the occurrence of fright factors in newspaper articles about wind turbines and health, we conducted a cluster analysis based on demographic census characteristics. Three subgroups were identified: Cluster 1 characteristics included communities with higher population density (>400 persons/km^2), education levels above the provincial mean, average house values between $300,000 and $400,000 and a median income of $61,000; examples of communities in Cluster 1 included Toronto, Hamilton, Sarnia, Orangeville and Kincardine. Cluster 2 included communities with a lower population density (<400 persons/km^2), education levels below the provincial average, average house values between $100,000 and $200,000 and a median income of $30,000. Examples of communities in Cluster 2 included Hanover, Owen Sound, Arran-Elderslie, Elliot Lake and Algoma. Together, these two clusters accounted for almost 60% of the variation in demographic characteristics of census subdivisions. A third cluster capturing four communities did not have a distinct census profile, explained only 20% of the variation in demographic characteristics and was excluded from further analysis. Within the two clusters, we identified the community newspaper with the largest number of articles and compared these for type and prevalence of fright factors. The representative community newspaper for Cluster 1 was the *Kincardine News* (n = 53), and the representative community newspaper for Cluster 2 was *the Owen Sound Sun Times* (n = 72).

None of the fright factors occurred significantly more often in the representative community newspapers as a function of the community cluster characteristics. However, 'involuntary exposure' tended to be mentioned more often in articles from Cluster 2 (n = 34) compared with Cluster 1 (n = 16) (X^2 = 3.69, df = 1, p = 0.055). With respect to timing relative to the Green Energy Act, newspaper articles from Cluster 2 had a significantly greater number of occurrences of the fright factor 'involuntary exposure' after vs. before the Green Energy Act (n = 30 vs. n = 4) (X^2 = 5.26, df = 1, p < 0.05). In the following extracts, we present illustrative examples newspaper coverage highlighting 'involuntary exposure' in Cluster 2 both before and after the Green Energy Act.

Before the Green Energy Act

> Extract from *the Owen Sound Sun Times*, March 2009: The primary issues of concern for Grey Highlands are that the act will remove local planning control over renewable energy projects as well as concerns over health issues and loss of property values.
>
> Extract from *the Owen Sound Sun Times*, April 2009: Protesters questioned how much wind generation is actually reducing greenhouse gas emissions and raised concerns about the visual impact on the landscape and the loss of local control over projects if the provincial Green Energy Act is made law.

After the Green Energy Act

> Extract from *the Owen Sound Sun Times*, Oct 2009: Municipalities with projects in their areas know, firsthand, how much trouble they are. When they tried to stop existing projects from expanding, they were taken to the Ontario Municipal Board where they were told they had to allow turbines because the provincial government said so.
>
> Extract from *the Owen Sound Sun Times*, March 2011: The minister addressed concerns raised by critics of the government's renewable energy policies contained in the Green Energy and Green Economy Act which takes away planning approval powers by local and county councils and replaces it with a poorly-defined consultation process.

Discussion

A content analysis of newspaper media is a convenient, low-cost and non-intrusive technique used to build understanding of how the public interprets health risk when risk perception surveys are not available (Driedger 2007, Mistry and Driedger 2012). In the study on which this article is based, we used systematic counting and recording to produce a quantitative description of fright factor content on wind turbines and health in Ontario newspaper articles relative to a major policy initiative. To our knowledge, no previous media analysis has documented the issue of wind turbines and health. The study of these results may help to fill gaps in the literature regarding newspaper media framing of wind energy and health.

Of the fright factors associated with environmental risks and human health (Bennett 1999), we found the most commonly reported were 'dread', 'poorly understood by science', 'involuntary exposure' and 'inequitable distribution'. The high number of citations for 'dread' and 'poorly understood by science', which we identified, is consistent with the literature on perceived risk associated with other technologies – electromagnetic fields (EMFs), power lines, cell phone radiofrequencies and cell phone base towers (Slovic 2000, Frick *et al.* 2002, Cousin and Siegrist 2011, Khiefets *et al.* 2010). The rapid rate of change in many technological sectors has made it difficult to characterise and study exposures prospectively, resulting in a knowledge deficit in both scientific and lay communities (Slovic 1987). The combination of dread and unknown consequences, when associated with technology, may lead to greater risk perceptions and result in stigmatisation and avoidance (Finucane *et al.* 2000). This effect may be exaggerated when coupled with frequent and dramatic news media coverage.

Local conditions, and their consequences, are experienced more directly by local media than national media (Viswanath *et al.* 2008). Therefore, our finding that both fright factors of 'dread' and 'poorly understood by science' were identified more frequently in community compared with national/provincial newspaper articles is not surprising. The audience for community newspapers generally have closer ties with local reporters, and expect information that affects their daily quality of life (Kaniss 1991). Subscribers to community newspapers are more likely to be local residents who live in a closer proximity to wind turbines. Thus, there may be an association between how often the fright factors 'dread' and 'poorly understood by science' were mentioned in the articles and the physical proximity of community residents to the actual wind energy installations; these fright factors were increasingly likely to occur in newspaper articles when the risk of exposure to wind turbines was greater. This potential relationship between locality of wind turbines, resident responses and public media discourse is an area for future research.

The fright factors of 'involuntary exposure' and 'inequitable distribution' were present in about half of the articles, with community newspapers emphasising inequitable distribution more often than national/provincial newspapers. This finding may reflect wind turbine locations in rural areas where community newspapers feature prominently. National/provincial newspapers, in contrast, are generally published in cities more distant from wind energy installations. Therefore, residents of rural areas might have a higher exposure than urban populations to the potential health risk of wind turbines. This represents an inequitable distribution of risk and may enhance and reinforce perceived risk among Ontario residents located near wind energy developments. Whether the perception of inequitable risk by local residents parallels the occurrence of this fright factor in the community newspaper reports remains to be determined.

A major function of the Green Energy Act was to streamline the approval process for wind energy installations in Ontario. This removed the ability of municipal governments to control the location of renewable energy sources in their communities. We expected to see an increase in the reporting of the fright factors 'involuntary exposure' and 'inequitable distribution'. However, only 'dread' and 'poorly understood by science' were reported more often after the Green Energy Act. Although our data do not indicate why the newspaper reporting of the fright factor 'poorly understood by science' increased after the Green Energy Act, this may reflect public dissatisfaction with the level of scientific evidence regarding wind turbines and potential health effects. Of note is that public calls for scientific study have been successful in altering behaviours towards other environmental and technological health risks, such as cell phones on airplanes, pesticides in schools and polyvinyl chloride children's toys (Kriebel *et al.* 2001). We also found a decreased prevalence in newspaper articles of the fright factor 'identifiable victims', following the Green Energy Act. The drop in the occurrence of this fright factor may be due to a greater collective voice and mobilisation of community groups, rather than concerns expressed by individuals. For example, the largest wind turbine opposition group in Ontario was established in late 2008 and has since grown to about 60 grassroot organisations (WCO 2011).

We used cluster analysis to study geographic variations in public health (Pedigo *et al.* 2011). Our intention was to contrast the prevalence of fright factors in newspaper articles in different communities. Following the Green Energy Act and extrapolating from a representative newspaper in each cluster with the greatest number of articles, Cluster 2 ('rural communities') had more articles linked to the fright factor of 'involuntary exposure' than did Cluster 1 ('urban communities'). The excerpts from the representative Cluster 2 newspaper showed that 'involuntary exposure' almost exclusively refers to the loss of municipal control over the placement of wind energy developments after the implementation of the Green Energy Act. Residents of rural communities may also feel disproportionately affected by legislation that removes municipal control, leading to feelings of powerlessness and a decreased ability to regain this control compared with urban communities.

The significant increase in news articles on wind turbines and potential health effects over time suggests that this topic is newsworthy. An increase in news coverage of an issue can result in audience negativism independent of the nature of the risk itself, and repeated public reactions to media can itself induce health consequences (Mazur and Lee 1993, Young *et al.* 2008). This is especially true of public exposure to new health information, which has been shown to increase health concerns for up to 2 weeks after the receipt of the information (Cousin and Siegrist 2011). Alternatively, an increase in newspaper coverage of an issue can lead to positive health behaviours, such as reporting on the H1N1 outbreak and increased demand for diagnostic testing (Olowokure *et al.* 2012). The increased frequency of newspaper coverage that focuses on human health reflects not only greater public discourse about health effects of wind turbines but a growing influence of the media in this debate.

The study on which this article is based had limitations. Our results and conclusions were restricted to a select number of Ontario newspapers, a handful of wind energy installations in the province, and did not reflect risk information presented in other important media outlets such as television or the internet. Newspaper articles were also retrieved through an online database, and manually searching newspaper websites and archives, which could potentially have biased their collection. The search string used to collect articles from the online database included terms such as illness and stress, which

may have biased our results to overrepresent negative news articles. However, the inclusion of these terms was necessary to capture the complete public discourse on health effects of wind turbines for the time period studied. A potential bias in this study is that more than half of the newspapers were owned by a single publisher. Although there is a variety of evidence to suggest that collective media ownership does not result in concentration of media content (Soroka 2002), there was still the possibility that newspaper coverage might reflect specific editorial agendas and selection bias rather than community concerns. We excluded duplicate articles from our analysis, which eliminated the potential syndication of stories across newspapers from the same publisher. Moreover, although each newspaper included in the study was publically available, they were generally sold individually or by subscription. Only those residents with the financial ability to purchase newspapers would have consistent exposure to fright factors embedded within news articles. We also recognise that there is the potential to miss relevant themes in the public discourse about wind turbines and health in Ontario because of the closed coding methods used. Although outside of the scope of this study, a qualitative analysis of these newspaper articles may identify several important emergent themes and contribute to building theory for future risk perception research. For example, the theme of political lobbying may be identified in a preliminary reading of the text, and further examined to reveal subthemes (Crabtree and Miller 1999).

Conclusion

Ontario newspaper articles on wind turbines and health contained a large number of fright factors, especially 'dread' and 'poorly understood by science', which both increased in frequency after the introduction of a major policy initiative and occurred more often in community relative to national/provincial newspapers. The information presented in mass media can affect public opinion related to wind turbines and influence the acceptance or resistance to renewable energy technology programmes in Ontario and potentially elsewhere (Dearing and Rogers 1996). Newspapers reporting of health concerns have widespread influence on the uptake of health campaigns, such as the HPV vaccination programme (Abdelmutti and Hoffman-Goetz 2009) and on consumer behaviours, such as purchasing genetically modified foods (Frewer *et al.* 2002). Findings from this content analysis represent a first step in documenting possible effects of newspaper reporting on the issue of wind turbines and health effects on individual, social or cultural norms (Riffe *et al.* 1998). Similar quantitative content analyses have contributed to understanding the public discourse about health risks in Canadian newspapers (Rachul *et al.* 2011, Holton *et al.* 2012). We suggest that other methodological approaches (for example, surveys or interviews) will be necessary to make inferences and predications about the effects of exposure to fright factors in the media on public perceptions on health risks from wind turbines.

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