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How the factoid of wind turbines causing 'vibroacoustic disease' came to be 'irrefutably demonstrated'

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Abstract

Objective: In recent years, claims have proliferated in cyberspace that wind turbines cause a large variety of symptoms and diseases. One of these, "vibroacoustic disease" (VAD) is frequently mentioned. The aim of this study is to examine the quality of the evidence on how VAD came to be associated with wind turbine exposure by wind farm opponents. **Methods:** Searches of the web (Google advanced) and major research databases for papers on VAD and wind turbines. Self-citation analysis of research papers on VAD. **Results:** Google returned 24,700 hits for VAD and wind turbines. Thirty-five research papers on VAD were found, none reporting any association between VAD and wind turbines. Of the 35 papers, 34 had a first author from a single Portuguese research group. Seventy-four per cent of citations to these papers were self-citations by the group. Median self-citation rates in science are around 7%. Two unpublished case reports presented at conferences were found asserting that VAD was "irrefutably demonstrated" to be caused by wind turbines. The quality of these reports was abject. **Conclusions:** VAD has received virtually no scientific recognition beyond the group who coined and promoted the concept. There is no evidence of even rudimentary quality that vibroacoustic disease is associated with or caused by wind turbines. **Implications:** The claim that wind turbines cause VAD is a factoid that has gone 'viral' in cyberspace and may be contributing to nocebo effects among those living near turbines.

Keywords

demonstrated, irrefutably, be, came, wind, disease, factoid, vibroacoustic, causing, turbines

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Competing interests

The authors declare that they have no competing interests.

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Abstract

Objective

In recent years, claims have proliferated in cyberspace that wind turbines cause a large variety of symptoms and diseases. One of these, “vibroacoustic disease” (VAD) is frequently mentioned. Seventeen reviews of the evidence for wind turbines causing harm have concluded the evidence to be poor yet regulatory authorities are now referencing health concerns as part of the rationale for set-back guidelines from residences, greatly reducing siting opportunities. The aim of this study is to examine the quality of the evidence on how VAD came to be associated with wind turbine exposure by wind farm opponents.

Methods

Searches of the web (Google advanced) and major research databases for papers on VAD and wind turbines. Self-citation analysis of research papers on VAD.

Results

Google returned 24,700 hits for VAD and wind turbines. Thirty five research papers on VAD were found, none reporting any association between VAD and wind turbines. Of the 35 papers, 34 had a first author from a single Portuguese research group. Seventy four per cent of citations to these papers were self-citations by the group. Median self-citation rates in science are around 7%. Two unpublished case reports presented at conferences were found asserting that VAD was “irrefutably demonstrated” to be caused by wind turbines. The quality of these reports was abject.

Conclusions

VAD has received virtually no scientific recognition beyond the group who coined and promoted the concept. There is no evidence of even rudimentary quality that vibroacoustic disease is associated with or caused by wind turbines.

Implications

The claim that wind turbines cause VAD is a factoid that has gone “viral” in cyberspace and may be contributing to nocebo effects among those living near turbines.

BACKGROUND

Modern wind farms began to be constructed from the early 1980s (1), yet opposition to them based on claims about putative adverse acute and chronic health impacts among those living nearby is relatively recent, with unpublished case reports being circulated from around 2002, more than 20 years later.(2, 3) In Australia for example, the Esperance 10 Mile Lagoon wind farm (Western Australia) began operating in 1987; Coober Pedy (SA) in 1990, Crookwell (NSW) in 1998 and the Codrington (Victoria) farm in 2001, all years before the first claims surfaced. Given frequent claims that acute effects can manifest within even minutes of exposure (e.g: "two acousticians themselves became sick … where they were taking measurements, within 20 minutes of being there") (4) gaps of many years between commencement of turbine operation and first complaints are suggestive of psychogenic and sociogenic factors characteristic of "modern health worries" (5, 6) being relevant. Modern health worries are often associated with new technology such as telephones, television, computers, microwave ovens, electric blankets, mobile phones and towers, wi-fi, smart electricity meters and here, wind turbines.

In the years since these early case reports, a multitude of claims about the health effects of wind turbine infrasound on humans, mammals, birds and even earthworms have proliferated in cyberspace. An on-going collection of such complaints currently lists 216 symptoms, diseases and aberrant behaviours said to be caused by turbine exposure. (7) Despite 17 reviews (8-24) undertaken in a range of countries including one from Australia's National Health and Medical Research Council, (15) concurring that the evidence for harm is poor, concerns about health have been recently named by an Australian political party as part of its reasoning for mandating 2 km minimum turbine set-back regulations from residences should it attain government.(25) The 2011 Australian Senate enquiry into the Social and Economic

Impact of Rural Wind Farms and a New South Wales public enquiry into proposed 2 km setbacks (2012) received many submissions from those claiming to have symptoms and diseases caused or exacerbated by wind turbines.(26, 27) Health concerns have also been prominent in opposition to turbines in parts of Canada (16), the USA (8) and the United Kingdom (28), and among opposition groups across 23 European nations.(29)

Vibroacoustic disease

"Vibroacoustic disease" (often abbreviated as VAD) is an outcome that many wind farm opponents attribute to turbine exposure. For example, in a recent submission to NSW Planning's Wind Farm Draft Guidelines, the NSW Landscape Guardians, a lobby group opposed to wind farms, wrote:

"Another source of health concern in relation to wind turbine infrasound is the work of Alves-Pereira and Castelo Branco, the specialists in Vibro-acoustic disease. They have shown that infrasound levels from a wind farm at a residence were higher than infrasound levels at a residence near a port grain terminal, known to be connected with cases of Vibro-acoustic disease".(30)

A group of Portuguese researchers began using the term vibroacoustic disease to describe a whole-body, multi-system pathology, said to be caused by chronic exposure to large pressure amplitude and low frequency noise with level greater than 90 dB SPL, frequency 0 to 500 Hz(31-37). The research group claims there are three stages in the progression of the disease which they hypothesise is caused by the chronic impact of vibrations from low frequency sound (32) (35) (see Table 1). These stages were developed from data on 140 male aircraft technicians, with exposure time referring to the time it took for 50% of subjects to develop the corresponding sign or symptom. (32)

However in 2010, the UK's Health Protection Agency reviewed the evidence on infrasound and health, concluding: "there is no evidence that infrasound at levels normally encountered in the environment will lead to the development of vibroacoustic disease. Further this disease itself has not gained clinical recognition. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects."(14).

In this paper, we investigate the extent to which vibroacoustic disease and its alleged association with wind turbine exposure has received scientific attention, the quality of that association and how the alleged association gained traction among opponents of wind farms. It should be noted that this paper is not a review of the broad field of health effects of wind turbines, but is a close examination of a particular claim made by some scientists.

METHODS

In August 2012, a search of Medline, Premedline, Scopus and Web of Science was undertaken using the following terms: "vibroacoustic" OR "vibro-acoustic" AND "disease" AND "wind". Original and review articles were included if they "vibroacoustic disease" in the title or abstract. An author self-citation analysis was then undertaken for all papers retrieved. Self-citation is defined as citations where the citing and the cited paper have at least one author in common(38).

Synchronous self-citations are those contained in the reference list of a paper and diachronous self-citations are those included in the citations a paper receives (39). Synchronous self-citations can be calculated by viewing the references within a paper while. citation databases are required to obtain diachronous self-citation rates. We used Scopus in

this analysis as it has previously been shown to have the greatest accuracy and retrieve the most citations (40).

An advanced Google search using the string “vibroacoustic” and “disease” and “wind” was then conducted on 10 different computers on 28 Aug 2012 with the average number of hits then calculated. Running the search across different computers owned by different people is important because Google search results can vary according one’s search history. The resulting Google returns were then searched in an attempt to locate any “grey” unpublished research about vibroacoustic disease and wind turbines.

RESULTS

All 10 computers returned 24,700 webpages via the advanced Google search. The peer reviewed journal search strategy for “vibroacoustic disease” retrieved 182 papers. Screening of titles and abstracts resulted in exclusion of 62 articles which used the term vibroacoustic in relation to either fetal ultrasound measurement or occupational measurement of noise (Figure 1). After removal of duplicates, a total of 35 papers were found on vibroacoustic disease (Figure 1). Of these, all but one had a first author from the same Portuguese research group. The 35 papers were published in journals with impact factors ranging from 0.36 – 3.96. (Table 2).

Together, the 35 papers had 550 citations, with 144 after removal of self-citations, giving a self-citation rate across all papers of 74%. The total reference count for the 35 papers was 1223 with 650 (53%) of these being self-citations of papers by any of the authors. Table 3 shows the diachronous author self-citation rates for the two leading authors in the group Castelo Branco (a surgical pathologist) (69%) and Alves-Pereira (an engineer) (36%).

Wind turbines and vibroacoustic disease

None of the papers contained any reference to wind turbines. The on-line grey literature Google search showed that the claim about wind turbines causing vibroacoustic disease was apparently first made on May 31 2007 in a press release by the Lisbon group three months ahead of a paper they planned to deliver describing two case studies at the Istanbul Inter-noise 2007 conference in late August 2007 (41) and again at a wind conference in Lyon, France in September 2007 (42). The release stated "These results *irrefutably demonstrate* [our emphasis] that wind turbines in the proximity of residential areas produce acoustical environments that can lead to the development of VAD (vibroacoustic disease) in nearby home-dwellers."(30).

The conference paper(43) compared infrasound measurements in the homes of two families: Family F who lived across a wide river from a deep water grain terminal and Family R, who lived in a farmhouse near four wind turbines located at distances of between 322 and 643 metres. Two in Family F had various pathologies described by the authors as VAD and a 12 year old boy in Family R had "memory and attention skill" problems in school and "tiredness" during physical education activities, both common problems in school children. The measured infrasound levels in Family R's house were higher than those in Family F's house. The noise measuring equipment used to measure infrasound in the two houses was different. The authors concluded unequivocally that Family R "will also develop VAD should they continue to remain in their home."

This claimed association was repeated by Alves-Pereira in an invited video-linked presentation to an NHMRC Wind Farms and Human Health Scientific Forum held on June 7,

2011 (44). In this presentation she focussed on the case study of Family R. Slide #23 (45) shows an arrow indicating the house concerned. It can be seen that there are many other houses in the area adjacent to the turbines, but her research group conducted no investigations of residents in any of these, as would be expected in any elementary epidemiological investigation. Again, Alves-Pereira asserted that wind turbine exposure was a plausible explanation for the boy's school problems. No other possible explanations were considered in the presentation or apparently investigated.

Alves-Pereira also referred to problems of "boxy" or "club" foot found in four horses kept at the property (slide #28)(45). This problem too, she suggested might be connected with exposure to wind turbines. Of five horses examined, four had boxy foot. The one that did not was acquired rather than bred on the farm. One other acquired horse also had boxy foot. Boxy foot is a common problem in horses and has many causes (46) yet none of these were mentioned nor investigated.

DISCUSSION

Across 35 papers, the Lisbon research group is almost entirely responsible for propagating the "disease" entity of vibroacoustic disease, self-citing at a rate (74%) seldom seen in any research field. Average diachronous self-citation rates across disciplines have found rates of around 7-35% (38, 40, 47). Self-citation can be useful as it allows research groups to contextualise their earlier investigations and highlight previous findings (48). However, self-citation can also be used to artificially increase the apparent scientific impact of a researcher's work and has been shown to increase an author's H-index by 12-24% (48, 49). With a hiatus of now 5 years since their last papers on vibroacoustic disease (33, 35), there

has been no further work published by other researchers, suggesting the disease was never taken seriously by others and has now “died”.

The subjects in these 35 papers were mostly aviation workers exposed to loud industrial aircraft noise, including sub-audible infrasound. Linking wind turbine exposure to VAD, a disease that virtually no one else in science even acknowledges, occurred through the two unpublished conference case studies described. These were of abject methodological quality, failing the most elementary tests of epidemiological investigation. The case studies:

- had n=2
- used different instrumentation to record low frequency noise
- had no control groups (ie: failed to compare low frequency noise levels in the two case houses with that in other adjacent houses or houses away from the alleged infrasound sources. There are many natural and artificial sources of infrasound other than wind turbines. These include wind, storms, ocean waves, refrigerators, sub-woofers, pumps, compressors, low speed fans and trains (50) as well as respiration, heartbeat and coughing.
- used no random selection of subjects
- had no researcher blindness integrity (ie those measuring the sound knew that health complaints had been made)
- failed to consider any possible other causes of the diseases and symptoms named
- took no account of inattention and lack of energy in school children being common
- used cases who had requested investigation from a research group whose members had invested many years promoting and heavily self-citing a disease entity not recognised by other scientists

Our findings raise questions about the judgement of the Australian NHMRC in inviting

Alves-Pereira to speak at an official forum on wind turbines and health. The aim of the forum, as described by the NHMRC forum chair, was to focus on evidence, published science and hear from international experts. The NHMRC chairperson declared that Alves-Pereira had been asked to present "to provide international scientific evidence relating to the possible health impacts of wind farms" (44). Her speaker's biographical note stated "Alves-Pereira, in discussion with physicians Amanda Harry in the U.K. and Nina Pierpont in the U.S., is now looking into the low-frequency noise and infrasound produced by industrial wind turbines, to determine whether they, too, can cause such vibroacoustic disease. Alves-Pereira's initial assessment based on noise measurements taken inside and outside the homes of wind turbine neighbours, is that turbines are indeed a likely cause of VAD." (51) This language some distance from that in her 2007 "irrefutably demonstrated" press release.

CONCLUSION

Factoids are questionable or spurious statements presented as facts, but which have no veracity. With some 24,700 mentions in cyberspace, the connection between VAD and wind turbines has gone "viral", is now commonly included in submissions to governments by anti-wind farms activists and often mentioned in media interviews. The term "vibroacoustic disease" resonates with a portentousness that may foment nocebo effects(52) among those hearing about it and assuming it to be an established disease classification, acknowledged in medicine. The cyberspace-megaphoned relationship between VAD and wind turbine exposure is a classic example of a contemporary health factoid, which was here unleashed by a press release containing the claim that on the basis of two uncontrolled case studies, the association was "irrefutably demonstrate[d]". Vibroacoustic disease should be considered a candidate for the archives of "non-diseases" (53). However in this case, this factoid is contributing to a regulatory environment which is severely limiting the siting of wind

turbines in Australia and thus lessening the contribution of wind energy to greenhouse gas reductions.

By naming and frequently publicising VAD and a plethora of other questionable "diseases"(7) said to be caused by wind turbines, those concerned to oppose their proliferation have sought to pull what are often extremely common symptoms and diagnoses found in any community such as fatigue, inattention, sleeping problems (some 33% of Australians report insomnia) (54), high blood pressure and mental health problems into memorable, quasi-scientific sounding entities. Wind turbines have the potential to make further major contributions to renewable energy generation, and thereby to reduce greenhouse gas emissions. Health concerns are being used by wind energy opponents to thwart new projects. Regulatory authorities should take care to critically examine the quality of evidence for claims that wind turbines harm health.

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Table 1. Stages of Vibroacoustic Disease

Clinical Stage	Exposure Time	Sign/Symptom
Stage I –Mild	2 years	Slight mood swings, indigestion and heart burn, mouth/throat infections, bronchitis
Stage II- Moderate	2-10 years	Chest pain, definite mood swings, back pain, fatigue, fungal, viral and parasitic skin infections, inflammation of stomach lining, pain and blood in urine, conjunctivitis, allergies
Stage III – Severe	>10 years	Psychiatric disturbances, haemorrhates (sic) of nasal, digestive and conjunctive mucosa, varicose veins and haemorrhoids, duodenal ulcers, spastic colitis, decrease in visual acuity, headaches, severe joint pain, intense muscular pain, neurological disturbances

Source: Alves-Pereira, M. and N. A. A. Castelo Branco (2007). "Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling." Progress in Biophysics and Molecular Biology **93**(1-3): 256-279.

Table 2. Publications on Vibroacoustic disease by year with author self-citation rates

Year	#	Journal	Journal Impact Factor	# Citations	Excluding self-citation	Diachronous Self-citation Rate	Synchronous Self-citation Rate
1999	21	Aviation, Space and Environmental Medicine	0.99	497	121	77%	53%
2000	0		-	-	-	-	-
2001	1	Aviation, Space and Environmental Medicine	0.99	7	1	86%	55%
2002	1	European Journal of Anatomy	-	9	1	89%	42%
2003	1	Revista Portuguesa de Pneumologia	0.36	4	0	100%	41%
2004	2	Noise and Health (1)	0.74	16	9	44%	63%
		European Journal of Lymphology & Related Problems (1)§	-	0	-	-	83%
2005	1	European Journal of Anatomy (1)§	-	3	0	100%	68%
2006	6	Revista Portuguesa de Pneumologia* (5)	0.36	1	1	0%	59%
		Central European Journal of Public Health (1)	2.27	3	1	67%	65%
2007	2	Progress in Biophysics & Molecular Biology (1)	3.96	9	9	0%	70%
		Revista Portuguesa de Pneumologia (1)	0.36	1	1	0%	70%
Total	**35**			**550**	**144**		

§ No journal impact factor available

Table 3. Self-citation rates and H-index for two vibroacoustic researchers

	Alves-Pereira	Castelo Branco
# Articles on Vibroacoustic Disease	17	48
Total # Citations for VAD Articles	116	679
Excluding Self-citation (Author)	74	213
Self-citation rate	36%	69%
Excluding self-citation (any author on original article)	40	186
H- Index	5	9
H-Index (excluding self-citations)	4	8

Figure 1 - Search Results for "Vibroacoustic Disease" and Wind Farms/Turbines