WIND FARMS AND HEALTH

According to the World Health Organisation's recent report, 'Night Noise Guidelines for Europe,'[1] environmental noise is emerging as one of the major public health concerns of the twenty-first century. It observes that, "Many people have to adapt their lives to cope with the noise at night," and the young and the old are particularly vulnerable. This is because hearing in young people is more acute and, in older people, a loss of hearing of higher sound frequencies renders them more susceptible to the effects of low frequency noise. It is a particularly troublesome feature of the noise generated by wind turbines due to its impulsive, intrusive and incessant nature. A recent case-control study conducted around two wind farms in New England has shown[2] that subjects living within 1.4 km of an IWT had worse sleep, were sleepier during the day, and had poorer SF36 Mental Component Scores compared to those living further than 1.4 km away. The study demonstrated a strongly significant association between reported sleep disturbance and ill health in those residing close to industrial wind turbines.

The major adverse health effects caused seem to be due to sleep disturbance and deprivation with the main culprits identified as loud noise in the auditory range, and low frequency noise, particularly infrasound. This is inaudible in the conventional sense, and is propagated over large distances and penetrates the fabric of dwellings, where it may be amplified. It is a particular problem at night, in the quiet rural settings most favoured for wind farms, because infrasound persists long after the higher frequencies have been dissipated.

Sleep is a physiological necessity and the sleep-deprived are vulnerable to a variety of health problems.[2,3] particularly Cardiovascular Disease in which nocturnal noise is an important factor.[4] Sleep deprivation in children is associated with increased bodyweight,[3,5] which is known to 'track' into later life, and predisposes to adult disease. That is why

"Encouraging more sleep" is a sensible target in the Public health Agency's current campaign to prevent obesity in children. It also causes memory impairment because memories are normally reinforced in the later, Rapid Eye Movement, phase of sleep; again, it is the young and the old who are most affected.

Sleep deprivation is associated with an increased likelihood of developing a range of chronic diseases including Type II Diabetes, cancer (eg breast with shift work[6]), Coronary Heart Disease[7,8] and Heart Failure.[9] Although the quality of the data are mixed, those on Heart Failure reported recently from the HUNT Study[9] are quite robust as they are based on 54,279 Norwegians free of disease at baseline (men and women aged 20-89 years). A total of 1412 cases of Heart Failure developed over a mean follow-up of 11.3 years. A dose-dependent relationship was observed between the risk of disease and the number of reported insomnia symptoms: i) Difficulty in initiating sleep; ii) Difficulty in maintaining sleep; and, iii) Lack of restorative sleep. The Hazard Ratios were '0' for none of these; '0.96' for one; '1.35' for two; and, '4.53' for three; this achieved significance at the 2% level. This means that such a result could occur once by chance if the study were to be repeated 50 times, Significance is conventionally accepted at the 5% level.

Another important, recent study is MORGEN which followed nearly 18,000 Dutch men and women, free of Cardiovascular Disease at baseline, over 10-14 years.[8] In this period there were 607 events: fatal CVD, non-fatal Myocardial Infarction and Stroke. Adequate sleep, defined as at least seven hours, was a protective factor which augmented the benefits conferred by the absence of four traditional cardiovascular risk factors. For example, the benefit of adequate sleep equalled the protective contribution of not smoking cigarettes. Given that cigarette smoking is such a potent risk factor for Cardiovascular Disease, this result is striking. The findings built on earlier ones from the MORGEN study.[7] It seems that adequate sleep is important in protecting against a range of Cardiovascular Diseases which

result when arteries of different sizes are compromised: large (coronary, cerebral) arteries in heart attacks and stroke, small arteries (arterioles) in heart failure.

All of these studies share the weakness that they are 'observational' as opposed to 'experimental' and, as such, their results do not constitute 'proof.' We now have the evidence of an experimental study carried out in human volunteers which shows that the expression of a large range of genes is affected by sleep deprivation of fairly short duration.[10] This might be the key to understanding why the health effects of sleep deprivation are so diverse. It could also shed light on the 'Wind Turbine Syndrome,' a cluster of symptoms which include sleep disturbance, fatigue, headaches, dizziness, nausea, changes in mood and inability to concentrate.[11] In this condition infrasound is a likely causal agent.

This group has now shown in another small intervention study that mistimed sleep desynchronized from the central circadian clock has a much larger effect on the circadian regulation of the human transcriptome (i.e., a reduction in the number of circadian transcripts from 6.4% to 1% and changes in the overall time course of expression of 34% of transcripts).[12] This may elucidate the reasons for the large excess of cardiovascular events associated with shift work found in a meta-analysis of over 2 million subjects in 34 studies.[13] The results demonstrate that any interference in normal sleeping patterns is inimical to cardiovascular health.

The old admonition that 'What you can't hear won't harm you,' sadly isn't true. It is now known that organ of Corti in the cochlea (inner ear) contains two types of sensory cells: one row of inner hair cells which are responsible for hearing; and, three rows of outer hair cells which are more responsive to low frequency sound.[14] The infrasound produced by wind turbines is transduced by the outer hair cells and transmitted to the brain by Type II afferent fibres. The purpose is unclear as it results in sleep disturbance. Perhaps it served some vital function in our evolutionary past which has persisted to our detriment today? In fact, many

animals use infrasound for communication and navigation. This could well have a genetic basis as it is only a minority, albeit a sizable one, which is affected. This may well be the group which is also liable to travel sickness. Schomer et al have now advanced the theory that as wind turbines increase in size they increasingly emit infrasound with a frequency below 1Hz (CPS).[15] Below this frequency the otoliths in the inner ear respond in an exaggerated way in a susceptible minority who will suffer symptoms of the Wind Farm Syndrome. Previously it was thought that the brain was only under the control of electrical and biochemical stimuli but there is new evidence that it is sensitive, in addition, to mechanical stimuli.[16]

The problem of infrasound and low frequency noise was well-recognised in a report by Casella Stanger,[17] commissioned by DEFRA in 2001, and since ignored: "For people inside buildings with windows closed, this effect is exacerbated by the sound insulation properties of the building envelope. Again mid and high frequencies are attenuated to a much greater extent than low frequencies." It continued: "As the A-weighting network attenuates low frequencies by a large amount, any measurements made of the noise should be with the instrumentation set to linear." It drew heavily upon the DOE's Batho Report of 1990.[18] In fact, these problems had already been elucidated and the measurement issues addressed in a trio of papers by Kelley (et al) in the 1980s.[19-21] This research again has been ignored or forgotten so the problem continues to be seriously underestimated. When measured using a tool which can detect it, levels of infrasound and low frequency noise are disturbingly high, with 'sound pressure levels' greater than previously thought possible.[22]

There are a number of other adverse effects associated with sleep deprivation. Tired individuals are more likely to have road traffic accidents and injure themselves while operating machinery. In addition, wind turbines can, and do, cause accidents by collapsing, blade snap, ice throw, and even going on fire. They induce stress and psychological disorder

from blade flicker, which also has implications for certain types of epilepsy and autism. Even the current planning process, with its virtual absence of consultation, is stress inducing, as is the confrontation between land owners, who wish to profit from erecting turbines, and their neighbours who dread the effects. Finally, wind turbines considerably reduce the value of dwellings nearby and this has a negative long term effect on their owners' and their families' health.[23] On top of this, increasing numbers of families will be driven into fuel poverty by spiralling electricity costs which are subsidising wind energy. It is galling that SSE's current, seductive advertising campaign is being supported from these sources.

'Wind Turbine Noise' was reviewed in an editorial in the British Medical Journal in 2012.[24] The authors concluded that "A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and noise levels that are permitted in most jurisdictions." This remains the case today. The Public Health Agency has dismissed this editorial as falling short of a 'systematic review,' which is fair enough, given the constraints of the format, yet ignores at least one, excellent, recent systematic review.[23] Interestingly, that review records the fact that in 1978 the British Government was found guilty in a case taken to Europe by the Irish Government of applying five techniques, including subjection to noise and deprivation of sleep. These were used in Ulster to 'encourage' admissions and to elicit information from prisoners and detainees. They amounted to humiliating and degrading treatment, ie torture.[23]

The Public Health Agencies in the UK are now relying on a document published in April 2013.[25] It was written by a group of acousticians at the University of Salford, which begs the question as to why such a group was selected to give advice on health issues. Since acousticians derive a significant proportion of their income from the wind industry, their scientific objectivity might be open to question. Similarly, if a profession, which worked closely with the tobacco industry, was asked to report on health, questions would be asked.

The wind industry has at times acted in a way that is reminiscent of the tobacco industry in the past. Recently a Vestas Powerpoint presentation from 2004 has surfaced[26] demonstrating that Vestas knew a decade ago that safer buffers were required to protect neighbours from wind turbine noise. They knew their pre-construction noise models were inaccurate and that "we know that noise from wind turbines sometimes annoys people even if the noise is below noise limits." Some of this is due to the methods they use to measure noise. Presenting mean amplitude data means that 50% of the peak noise is disguised. In 2011 the CEO of Vestas wrote[27] to the Danish Minister of Environment admitting that it was not technically possible to produce wind turbines which produced less noise. Simiarly, we are repeatedly told that modern turbines are quieter and produce less ILFN which in reality is the reverse of the case.[28]

The Salford Report concludes that there is "some evidence for sleep disturbance which has found fairly wide, though not universal, acceptance." The increasing weight of evidence of sleep deprivation's association with several chronic diseases is totally ignored. The authors of the report are at pains to deny any 'direct' health effects. In terms of prevention any differentiation between 'direct' and 'indirect' is irrelevant: the introduction of iodine supplementation in milking cattle to improve their "reproductive performance" during the 1960s indirectly led to a reduction in endemic goitre in humans. This was thanks to the unforeseen spillover of iodine into milk and dairy products.[29]

In 2008 the distinguished American acoustic engineers, George Kamperman, and Richard James posed the question,[30] "What are the technical options for reducing wind turbine noise emission at residences?" They observed that there were only two options: i) Increase the distance between source and receiver; or, ii) Reduce the source sound power emission. It is generally accepted that as larger and larger wind turbines are built, the noise problems are aggravated.[29] They added[30] that neither solution is compatible with the

objective of the wind farm developer to maximise the wind power electrical generation within the land available.

Although the associations between noise pollution and ill health can be argued against, and there are gaps in our knowledge, there is sufficient evidence to cause grave misgivings about its safety. Further research, supported by adequate funding, remains necessary. Good and caring Government should entailcting with greater caution when its policies could jeopardise the health and human rights of its people. It is essential that the *Primum non nocere,* or 'Precautionary', principle should be applied.

In conclusion, there are serious adverse health effects associated with noise pollution generated by wind turbines. It is essential that separation distances between human habitation and wind turbines are increased. There is an international consensus emerging for a separation distance of 2 km, indeed some countries are opting for 3 km. The current guideline on separation distance is based on ETSU-R-97 and is manifestly out of date. It is only relevant to the small turbines of that era. The vastly increased scale of today's turbines means that the current recommendation on turbine separation is grossly inadequate.

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