



This is an excerpt from IARO Report (IARO24-5):

“Health Report on a Rural Sheep Farm in Scotland.”

[Critical Review of Marshall N, Cho G, Toelle BG, Tonin R, Bartlett DJ, et al. (2023) The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomised Crossover Study in Noise-Sensitive, Healthy Adults. Environmental Health Perspectives, 131(3): 1-10. <https://pubmed.ncbi.nlm.nih.gov/36946580/>]

(All Figures and Paragraphs referred to, but not included, in this excerpt can be found in the Full Report, available at iaro.org.nz)

I. Immediate effects of infrasound exposure

214. In the 2023 study by Marshall *et al.*,^{301, 302} the objective is stated as follows:

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- 297 Footnote 5 of the Letter. Marshall N, Cho G, Toelle BG, Tonin R, Bartlett DJ, *et al.* (2023) The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomised Crossover Study in Noise-Sensitive, Health Adults. *Environmental Health Perspectives*, 131(3): 1-10. <https://pubmed.ncbi.nlm.nih.gov/36946580/> [website added]
- 298 Footnote 6 of the Letter. Majjala PP, Kurki I, Vainio L, Pakarinen S, Kuuramo C, *et al.* (2021) Annoyance, perception, and physiological effects of wind turbine infrasound. *Journal of the Acoustical Society of America*, 149(4): 2238-2248. <https://pubmed.ncbi.nlm.nih.gov/33940893/> [website added]
- 299 Footnote 7 of the Letter. Turunen AW, Tittanen P, Yli-Tuomi T, Taimisto P, Lanki T. (2021) Symptoms intuitively associated with wind turbine infrasound. *Environmental Research*, 192: 1-9. <https://pubmed.ncbi.nlm.nih.gov/33131679/> [website added]
- 300 As indicated in Paragraphs 37 and 40, the primary reason for such a comprehensive approach to this IARO Health Report is to provide an educational and instructive document for the NHS-Highland medical staff, with the ultimate purpose of benefiting the Scottish Citizen.
- 301 Marshall N, Cho G, Toelle BG, Tonin R, Bartlett DJ, *et al.* (2023) The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomised Crossover Study in Noise-Sensitive, Health Adults. *Environmental Health Perspectives*, 131(3): 1-10. <https://pubmed.ncbi.nlm.nih.gov/36946580/>
- 302 Disclaimer included in the 2023 Marshall *et al.* paper: “All of the authors have superannuation accounts which are compulsory in Australia and these accounts may contain investments in both traditional and renewable energy, including wind turbines. R.T. is the founding principal of Renzo Tonin Associates who have previously worked as consultants for the NSW Department of Planning on several wind farms in NSW, Australia. None of the investigators have any other pecuniary interest or academic conflicts of interest in the outcomes of this study.”

We aimed to test the effects of 72 h of infrasound (1.6–20 Hz at a sound level of ~ 90 dB pk re 20 microPa, ^[303, 304] simulating a wind turbine infrasound signature) exposure on human physiology, particularly sleep.

215. In Medical Sciences, this type of study purports to investigate the immediate effects of exposure, as opposed to long-term effects:

Our principal hypothesis was that exposure to infrasound in healthy individuals, at a level of ~ 90 dB pk re 20 microPa compared with the sham infrasound, increases WASO ^[305]—a measure of sleep disturbance—and worsens other measures of sleep quality, mood, WTS ^[306] symptoms, and other electrophysiological measures. In addition, as a positive control, we also tested whether audible traffic noise, a mixture of road (motorbike, truck, car) and aircraft noise (at a sound level of 40–50 dB LAeq; night and 70 dB LAFmax transient maxima) had an adverse impact on these same outcomes, when compared with sham infrasound.³⁰⁷

216. The conclusions of this study were:

Our study found no evidence that 72 h of exposure to a sound level of ~ 90 dB pk re 20 microPa of simulated wind turbine infrasound in double-blind conditions perturbed any physiological or psychological variable. None of the 36 people exposed to infrasound developed what could be described as WTS. Our study is unique because it measured the effects of infrasound alone on sleep. This study suggests that the infrasound component of WTN [wind turbine noise] is unlikely to be a cause of ill-health or sleep disruption, although this observation should be independently replicated.

217. The dose presented to these subjects “simulating a wind turbine infrasound signature” was questioned by IARO scientists, and correspondence with co-author R. Tonin was exchanged (in May 2023) to ascertain what “simulated wind turbine infrasound” meant.

303 See Appendix 1—Medical Sciences: IV. How is noise quantified?

304 See Appendix 2—Physics of Acoustics: I. What is Sound?

305 WASO = Wakefulness After Sleep Onset is the total number of minutes that an individual is awake after having initially fallen asleep.

306 WTS = Wind Turbine Syndrome. See: Pierpont N. (2009) Wind Turbine Syndrome: A Report on a Natural Experiment. K-Selected Books: Santa Fe, New Mexico, USA.
https://www.researchgate.net/publication/265247204_Wind_Turbine_Syndrome_A_Report_on_a_Natural_Experiment

307 Marshall N, Cho G, Toelle BG, Tonin R, Bartlett DJ, et al. (2023) The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomised Crossover Study in Noise-Sensitive, Healthy Adults. *Environmental Health Perspectives*, 131(3): 1-10.
<https://pubmed.ncbi.nlm.nih.gov/36946580/> [Footnotes contained in the original text are not included.]

218. Regrettably, the material provided by co-author R. Tonin was regarded by IARO scientists as unsatisfactory, if “simulating a wind turbine infrasound signature” was the objective.³⁰⁸
219. Nevertheless, for the sake of scientific discussion, it will be temporarily accepted that the subjects of this study were actually presented with a properly simulated wind turbine infrasound signature.
220. The idea seems to have been to investigate immediate responses to the simulated wind turbine infrasound signature, but as measured by parameters that, perhaps, were not so relevant for assessing immediate responses.^{309, 310, 311, 312, 313, 314, 315}
221. Another questionable practice was the selection of the “healthy individuals” as study subjects. To the understanding of IARO scientists, no evaluation was made regarding prior exposures³¹⁶ to infrasound and low frequency noise.^{317, 318}
222. Marshall *et al.* explain the viewpoint that foundationally justifies their study:

People who suffer from WTS [Wind Turbine Syndrome³¹⁹] report that their symptoms begin quickly when they are exposed to infrasound from wind

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- 308 The acoustic pattern used to simulate the wind turbine signal had a sawtooth profile, not the short-duration pulses of WTAS, see Figure 3. A sawtooth-shaped wave has a quick onset, a slow decay, and only locally oscillates the air. WTAS has a rapid onset and decay, and ‘pumps the air’ (as proposed by Dr Stephan Kaula, Germany), rather than only causing the local oscillations that are typically seen in airborne, acoustic propagation phenomena.
 - 309 See Appendix 4—Clinical & Biological Matters, Section 3—Occupational and Residential Exposures: I. Why are occupational exposures important to understand environmental exposures?
 - 310 See Appendix 4—Clinical & Biological Matters, Section 3—Occupational and Residential Exposures: II. What extra-auditory medical conditions do noise-exposed workers develop?
 - 311 See Appendix 4—Clinical & Biological Matters, Section 3—Occupational and Residential Exposures: III. Do the extra-auditory medical conditions seen in noise-exposed workers also emerge in residential infrasonic exposures?
 - 312 Mohr GC, Cole JJN, Guild E, von Gierke HE. (1965) Effects of low-frequency and infrasonic noise on man. *Aerospace Medicine*, 36: 817-24.
 - 313 Ponomarev VI, Tysik A, Kudryavtseva VI, Barer AS. (1969) Biological action of intense wide-band noise on animals. *Problems of Space Biology NASA TT F-529*, 7(May): 307-9.
 - 314 Castelo Branco NAA, Gomes-Ferreira P, Monteiro E, Costa e Silva A, Reis Ferreira J, Alves-Pereira M. (2003) Respiratory epithelia in Wistar rats after 48 hours of continuous exposure to low frequency noise. *Journal of Pneumology, formerly Revista Portuguesa Pneumologia*, IX (6): 474-79. <https://pubmed.ncbi.nlm.nih.gov/15190432/>
 - 315 Castelo Branco NAA, Reis Ferreira J, Alves-Pereira M. (2007). Respiratory pathology in vibroacoustic disease: 25 years of research. *Journal of Pneumology, formerly Revista Portuguesa Pneumologia*, XIII (1): 129-135. <https://pubmed.ncbi.nlm.nih.gov/17315094/>
 - 316 Including, foetal, childhood and young adult exposures in residential, occupational, and leisurely settings. See Appendix 1—Medical Sciences: II. What parameters are important when investigating the biological effects of exposures to physical agents of disease.
 - 317 See Appendix 1—Medical Sciences: X. How are control populations selected for noise studies.
 - 318 See Appendix 1—Medical Sciences: XI. What happens when control populations are incorrectly selected?
 - 319 Pierpont N. (2009) *Wind Turbine Syndrome: A Report on a Natural Experiment*. K-Selected Books: Santa Fe, New Mexico, USA. https://www.researchgate.net/publication/265247204_Wind_Turbine_Syndrome_A_Report_on_a_Natural_Experiment

turbines and are then sustained.^[320] Our scientifically robust study provides evidence to address this claim. The Australian NHMRC [National Health and Medical Research Council] report that gave rise to our study made note of this “absence of evidence” rather than concluding an “evidence of absence” owing to the lack of any laboratory-controlled double-blind experiments of sufficient duration and intensity to hypothetically induce WTS in a human.³²¹

223. “Induce WTS in a human”?³²² As far as is understood by IARO scientists, WTS is not commonly viewed as an immediate effect of the exposure to this agent of disease.³²³
224. The expression “laboratory-controlled double-blind experiments of sufficient duration and intensity” as applied to the matter at hand is simultaneously unethical, dangerous, and unnecessary.^{324, 325}
225. Is it the desire of the Australian NHMRC to expose subjects to a toxic agent—which is very difficult, if not impossible, to reproduce in laboratory settings—until some clearly severe health endpoint is observed? While tens of thousands of citizens are sitting in real-life laboratories being ‘accused’ of developing psychosomatic disorders?³²⁶
226. This methodology is considered by IARO scientists to reflect sub-standard practices of Scientific Inquiry.

320 See Appendix 4—Clinical & Biological Matters, Section 1-Cellular and Tissue Biology. III. Biological tissues are viscoelastic—What does this mean?

321 Marshall N, Cho G, Toelle BG, Tonin R, Bartlett DJ, *et al.* (2023) The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomised Crossover Study in Noise-Sensitive, Healthy Adults. *Environmental Health Perspectives*, 131(3): 1-10. <https://pubmed.ncbi.nlm.nih.gov/36946580/> [Footnotes contained in the original text are not included.]

322 “The causes of this syndrome have been the subject of substantial international controversy. Proponents have contended that the symptoms that compose this syndrome are caused by low frequency subaudible infrasound generated by wind turbines. Critics have argued that these symptoms are psychological in origin and are attributable to placebo effects. The Australian National Health and Medical Research Council Wind Farms and Human Health Reference Group concluded that the available evidence was not sufficient to establish which, if either, of these explanations is correct.” See: Marshall N, Cho G, Toelle BG, Tonin R, Bartlett DJ, *et al.* (2023) The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomised Crossover Study in Noise-Sensitive, Healthy Adults. *Environmental Health Perspectives*, 131(3): 1-10. <https://pubmed.ncbi.nlm.nih.gov/36946580/>

323 Pierpont N. (2009) *Wind Turbine Syndrome: A Report on a Natural Experiment*. K-Selected Books: Santa Fe, New Mexico, USA. https://www.researchgate.net/publication/265247204_Wind_Turbine_Syndrome_A_Report_on_a_Natural_Experiment

324 What kind of “laboratory-controlled double-blind experiments of sufficient duration and intensity” were conducted for asbestos contamination leading to asbestosis? Or for issues related to second-hand smoking, use of glyphosates, etc?

325 Alves-Pereira M, Rapley B, Bakker H, Summers R. (2019) Acoustics and Biological Structures. In: Abiddine Fellah ZE, Ogam E. (Eds) *Acoustics of Materials*. IntechOpen: London. DOI: 10.5772/intechopen.82761.

326 In the opinion of IARO scientists, had this study been performed on 3 groups of people, differentiated by the extent of their prior exposures (mild, moderate, or extensive), and, abiding by appropriate selection criteria of the study population, then, perhaps, statistically useful numbers could have been obtained, and scientifically useful results could have been achieved. The inability to reproduce ‘wind turbine infrasound’ under laboratorial conditions, however, would still render this study as irremediably flawed, while its overall design could be deemed ethically questionable.

227. In conclusion, in the opinion of IARO scientists, the effort expended by these authors to conduct this study is laudable (particularly given the position of the Australian NHMRC), even though, scientifically, within the realm of Medical Sciences and dose-response relationships, its results are inconsequential.