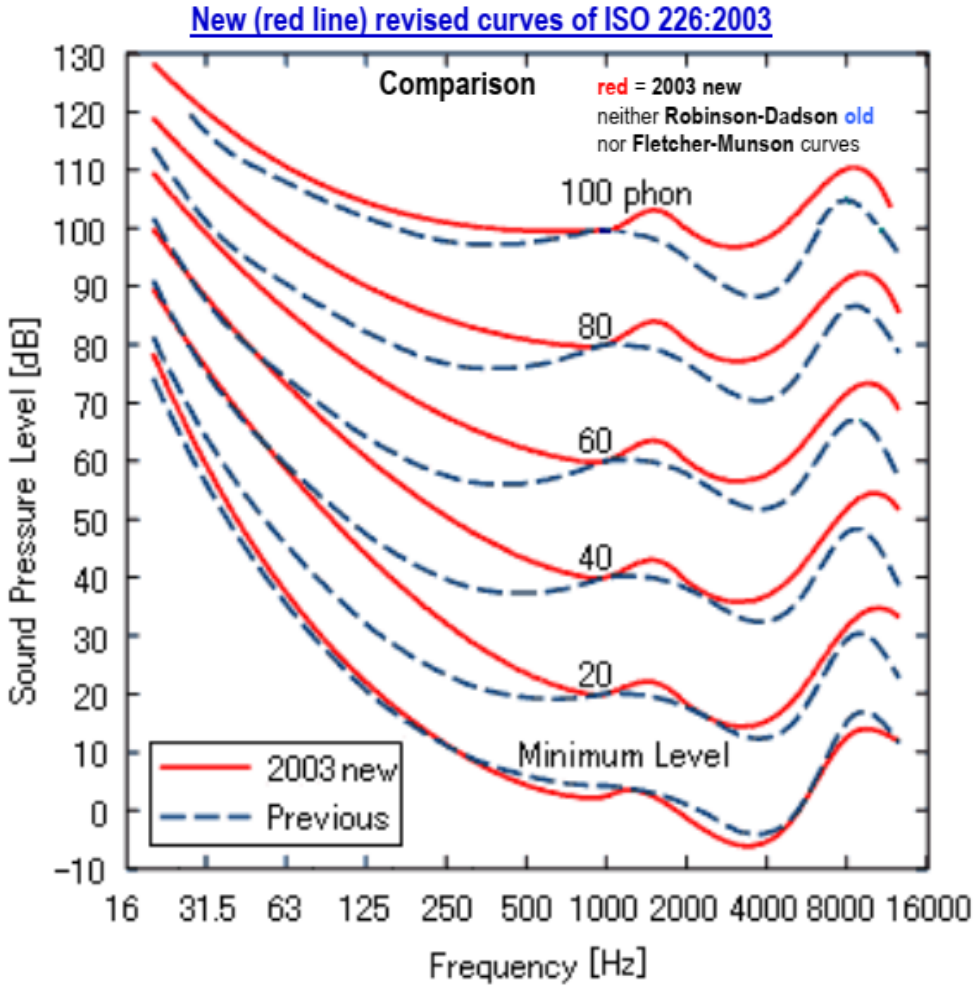
Windrad-Lärm & Gesundheit

Facts and Fakes

Lärm mit tiefer Frequenz



- Keine scharfe Grenze zu Infraschall
- Hörbar erst ab hohen Energien
- Wenn hörbar, dann rasch sehr laut
- Individuell sehr unterschiedliche Schwellen (± 5 dB)

- Schwer zu dämmen (Kopfhörer in Bim)
- Wenn tonal, sehr störend
- Messtechnisch problematisch
- Resonanzfrequenzen

Windräder und „Infraschall“

- Vornehmlich Windgeräusch (+ Trafo, mechanische Anlagen)
- Wind kann heulen, pfeifen, blasen,…
  - Aber meist eher ein breitbandiges Rauschen
- Windrad-Lärm oft nicht von anderem Wind-Geräusch unterscheidbar
- Außer: rhythmische Änderung der Lautstärke (Amplituden-Modulation)
  - Immer, wenn ein Rotor vor Turm vorbei geht (± 1 Hz)
  - Habe ich in maximal 500 m Entfernung noch gehört, nicht immer hörbar
- Derzeitige Windräder: nicht wesentlich tiefenbetont, kaum tonal

Studie über sehr energiereiche tief-frequenten (ca. 100 Hz) Schall (Labor) fand biologische Schäden. Im Abstract irrtümlich von „Infraschall“ geschrieben. Quelle der Infraschall-Angst in Internet-Foren.

Ein pensionierter Professor der MedUniWien

- Praktischer Arzt
- Nie Schallgutachten geschrieben oder Schallmessung begleitet
- Haus im Waldviertel, in der Nähe soll ein Windpark errichtet werden
- Er beginnt sich dagegen zu engagieren

- Inzwischen tritt er überall in Österreich auf und berichtet:

Windrad-Lärm > 15 dB(A) verursacht Herzinfarkt

(Poulsen et al. 2019, https://doi.org/10.1289/EHP3340)

A Section 508–conformant HTML version of this article
is available at https://doi.org/10.1289/EHP3340.

Long-Term Exposure to Wind Turbine Noise and Risk for Myocardial Infarction and Stroke: A Nationwide Cohort Study

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Background: Noise from wind turbines (WTs) is reported as more annoying than traffic noise at similar levels, raising concerns as to whether WT noise (WTN) increases risk for cardiovascular disease, as observed for traffic noise.

Objectives: We aimed to investigate whether long-term exposure to WTN increases risk of myocardial infarction (MI) and stroke.

Methods: We identified all Danish dwellings within a radius 20 times the height of the closest WT and 25% of the dwellings within 20–40 times the height of the closest WT. Using data on WT type and simulated hourly wind at each WT, we estimated hourly outdoor and low frequency (LF) indoor WTN for each dwelling and derived 1-y and 5-y running nighttime averages. We used hospital and mortality registries to identify all incident cases of MI ($n = 19{,}145$) and stroke ($n = 18{,}064$) among all adults age 25–85 y ($n = 717{,}453$), who lived in one of these dwellings for ≥one year over the period 1982–2013. We used Poisson regression to estimate incidence rate ratios (IRRs) adjusted for individual- and area-level covariates.

Results: IRRs for MI in association with 5-y nighttime outdoor WTN >42 (vs. <24) dB(A) and indoor LF WTN >15 (vs. <5) dB(A) were 1.21 [95% confidence interval (CI): 0.91, 1.62; 47 exposed cases] and 1.29 (95% CI: 0.73, 2.28; 12 exposed cases), respectively. IRRs for intermediate categories of outdoor WTN [24–30, 30–36, and 36–42 dB(A) vs. <24 dB(A)] were slightly above the null and of similar size: 1.08 (95% CI: 1.04, 1.12), 1.07 (95% CI: 1.00, 1.12), and 1.06 (95% CI: 0.93, 1.22), respectively. For stroke, IRRs for the second and third outdoor exposure groups were similar to those for MI, but near or below the null for higher exposures.

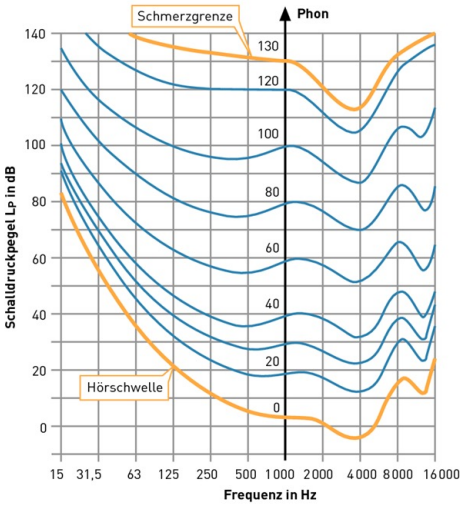
Conclusions: We did not find convincing evidence of associations between WTN and MI or stroke. https://doi.org/10.1289/EHP3340

Poulsen et al.

- Voll-Erhebung aller Anrainer von Windkraftanlagen in Dänemark
- Schallbelastung an der meistexponierten Fassade gemittelt über Verteilung der Windstärke (Schallemission) und Windrichtung (Schallausbreitung)
- Maximale mittlere Schallpegel (N): über 42 dB(A) ≈ L(DEN) 48,4 dB(A)
- Innen: Außen-Pegel + Bauart des Hauses (Isolierung) 10-160 Hz
- Maximale mittlere Schallpegel innen über 15 dB(A) (???)

Warum A-bewertete Pegel im Bereich tiefer Frequenzen?

- Tiefe Frequenzen lassen sich schlechter isolieren.
- Stärkere individuelle Variation der Hörschwelle.
- Steilerer Anstieg der Lautheit mit der Schallenergie.
- A-Bewertung nicht sinnvoll, aber in DK üblich.



Resultate 1

Table 4. Associations between mean 1- and 5-year exposure to residential A-weighted outdoor wind turbine noise and risk of myocardial infarction and stroke.

	Myocardial infarction				Stroke			
Outdoor wind turbine noise	Person-years	N cases	Crude IRR (95% CI)[a]	Adjusted IRR (95% CI)[b]	Person-years	N cases	Crude IRR (95% CI)[a]	Adjusted IRR (95% CI)[b]
1-year mean exposure								
<24 dB(A)	5,543,711	13,916	1 (ref)	1 (ref)	5,562,511	13,136	1 (ref)	1 (ref)
24–30 dB(A)	1,313,384	3,756	1.10 (1.06-1.14)	1.09 (1.05-1.13)	1,318,515	3,596	1.06 (1.02-1.10)	1.08 (1.04-1.12)
30–36 dB(A)	467,029	1,200	1.05 (0.99-1.11)	1.08 (1.02-1.15)	468,658	1,136	1.03 (0.97-1.10)	1.10 (1.03-1.17)
36–42 dB(A)	96,282	228	0.99 (0.87-1.13)	1.07 (0.94-1.22)	96,736	175	0.84 (0.72-0.97)	0.92 (0.80-1.07)
≥42 dB(A)	19,685	45	1.09 (0.81-1.46)	1.21 (0.90-1.63)	19,819	21	0.62 (0.41-0.95)	0.71 (0.46-1.08)
5-year mean exposure								
<24 dB(A)	5,644,428	14,151	1 (ref)	1 (ref)	5,664,088	13,205	1 (ref)	1 (ref)
24–30 dB(A)	1,265,628	3,616	1.09 (1.05-1.13)	1.08 (1.04-1.12)	1,270,239	3,566	1.07 (1.03-1.11)	1.09 (1.05-1.13)
30–36 dB(A)	425,855	1,119	1.04 (0.97-1.10)	1.07 (1.00-1.12)	427,200	1,095	1.04 (0.98-1.11)	1.10 (1.03-1.17)
36–42 dB(A)	85,193	212	0.99 (0.87-1.14)	1.06 (0.93-1.22)	85,595	175	0.87 (0.75-1.01)	0.95 (0.82-1.11)
≥42 dB(A)	18,986	47	1.10 (0.82-1.46)	1.21 (0.91-1.62)	19,117	23	0.62 (0.41-0.94)	0.69 (0.46-1.05)

Note: CI, confidence interval; IRR, incidence rate ratio.
[a]Adjusted for age, sex, and calendar year.
[b]Adjusted for age, sex, calendar year, personal income, education, marital status, work-market affiliation, area-level socioeconomic status, type of dwelling, traffic load in 500-m radius, and distance to major road.

- Keine Dosis-Wirkungs-Beziehung. (Rohe IRR > adjustierte IRR)
- Kein Unterschied zwischen 1-Jahr und 5-Jahr Belastung.
- Protektiver Effekt bei Schlaganfall.
- Keine signifikanten Ergebnisse.

Resultate 2

Table 5. Associations between mean 1- and 5-year exposure to residential A-weighted indoor low frequency wind turbine noise and risk of myocardial infarction and stroke.

Indoor low frequency wind turbine noise	Myocardial infarction				Stroke			
	Person-years	N cases	Crude IRR (95% CI)[a]	Adjusted IRR (95% CI)[b]	Person-years	N cases	Crude IRR (95% CI)[a]	Adjusted IRR (95% CI)[b]
1-year mean exposure								
<5 dB(A)	7,031,863	18,189	1 (ref)	1 (ref)	7,056,494	17,157	1 (ref)	1 (ref)
5–10 dB(A)	329,970	780	0.97 (0.91-1.05)	1.04 (0.96-1.12)	331,166	749	0.94 (0.87-1.01)	1.02 (0.95-1.10)
10–15 dB(A)]	72,551	165	0.97 (0.83-1.13)	1.09 (0.93-1.27)	72,847	148	0.88 (0.75-1.04)	1.00 (0.85-1.18)
≥15 dB(A)	5,706	11	0.80 (0.44-1.44)	0.92 (0.51-1.67)	5,732	10	0.76 (0.41-1.40)	0.89 (0.48-1.65)
5-year mean exposure								
<5 dB(A)	7,097,455	18,319	1 (ref)	1 (ref)	7,122,406	17,288	1 (ref)	1 (ref)
5–10 dB(A)	283,001	681	0.96 (0.89-1.04)	1.02 (0.95-1.11)	283,933	656	0.92 (0.85-1.00)	0.99 (0.92-1.07)
10–15 dB(A)]	55,408	133	0.97 (0.82-1.15)	1.08 (0.91-1.28)	55,660	111	0.81 (0.67-0.97)	0.91 (0.75-1.10)
≥15 dB(A)	4,226	12	1.11 (0.63-1.96)	1.29 (0.73-2.28)	4,239	9	0.87 (0.45-1.67)	1.02 (0.53-1.96)

Note: CI, confidence interval; IRR, incidence rate ratio.

[a]Adjusted for age, sex and calendar-year.

[b]Adjusted for age, sex, calendar year, personal income, education, marital status, work-market affiliation, area-level socioeconomic status, type of dwelling, traffic load in 500-m radius and distance to major road.

- 12 Fälle in höchster Kategorie (47 bei Außenpegeln). (Selbst eine 30%ige Risiko-Zunahme wären wenige Fälle!)
- Keine Dosis-Wirkungsbeziehung bei Schlaganfall.
- Keine Dosis-Wirkungsbeziehung bei 1-Jahr Belastung.
- Keine signifikanten Ergebnisse.

Außen-Lärm bleibt gleich. Fehlende Isolierung erhöht das Risiko, nicht der Lärm der Windräder!

The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomized Crossover Study in Noise-Sensitive, Healthy Adults. (EHP, März 2023)

Background: Large electricity-generating wind turbines emit both audible sound and inaudible infrasound at very low frequencies that are outside of the normal human range of hearing. Sufferers of wind turbine syndrome (WTS) have attributed their ill-health and particularly their sleep disturbance to the signature pattern of infrasound. Critics have argued that these symptoms are psychological in origin and are attributable to nocebo effects.

Objectives: 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 μPa, simulating a wind turbine infrasound signature) exposure on human physiology, particularly sleep.

Methods: We conducted a randomized double-blind triple-arm crossover laboratory-based study of 72 h exposure with a >10-d washout conducted in a noise-insulated sleep laboratory in the style of a studio apartment. The exposures were infrasound (~90 dB pk), sham infrasound (same speakers not generating infrasound), and traffic noise exposure [active control; at a sound pressure level of 40–50 dB $LA_{eq,night}$ and 70 dB LAF_{max} transient maxima, night (2200 to 0700 hours)]. The following physiological and psychological measures and systems were tested for their sensitivity to infrasound: wake after sleep onset (WASO; primary outcome) and other measures of sleep physiology, wake electroencephalography, WTS symptoms, cardiovascular physiology, and neurobehavioral performance.

Results: We randomized 37 noise-sensitive but otherwise healthy adults (18–72 years of age; 51% female) into the study before a COVID19-related public health order forced the study to close. WASO was not affected by infrasound compared with sham infrasound (−1.36 min; 95% CI: −6.60, 3.88, $p = 0.60$) but was worsened by the active control traffic exposure compared with sham by 6.07 min (95% CI: 0.75, 11.39, $p = 0.02$). Infrasound did not worsen any subjective or objective measures used.

Discussion: Our findings did not support the idea that infrasound causes WTS. High level, but inaudible, infrasound did not appear to perturb any physiological or psychological measure tested in these study participants. https://doi.org/10.1289/EHP10757

Schlussfolgerung

- Schall tiefer Frequenz ist ein Problem.
- Lärm von Windrädern enthält auch tiefe Frequenzen, aber weniger als andere häufige Schallquellen.
- Wir begrenzen Lärm von Windrädern mit L(DEN)=45 dB(A).
- Das entspricht 38,6 dB(A) in der Nacht, nicht 42 dB(A) und mehr!

WHO European Noise Guidelines 2019

- Wenn hörbar und von natürlichem (Wind-)geräusch unterscheidbar,
- …dann ist Belästigung möglich, abhängig von persönlicher Einstellung.