

Sound of Pain:

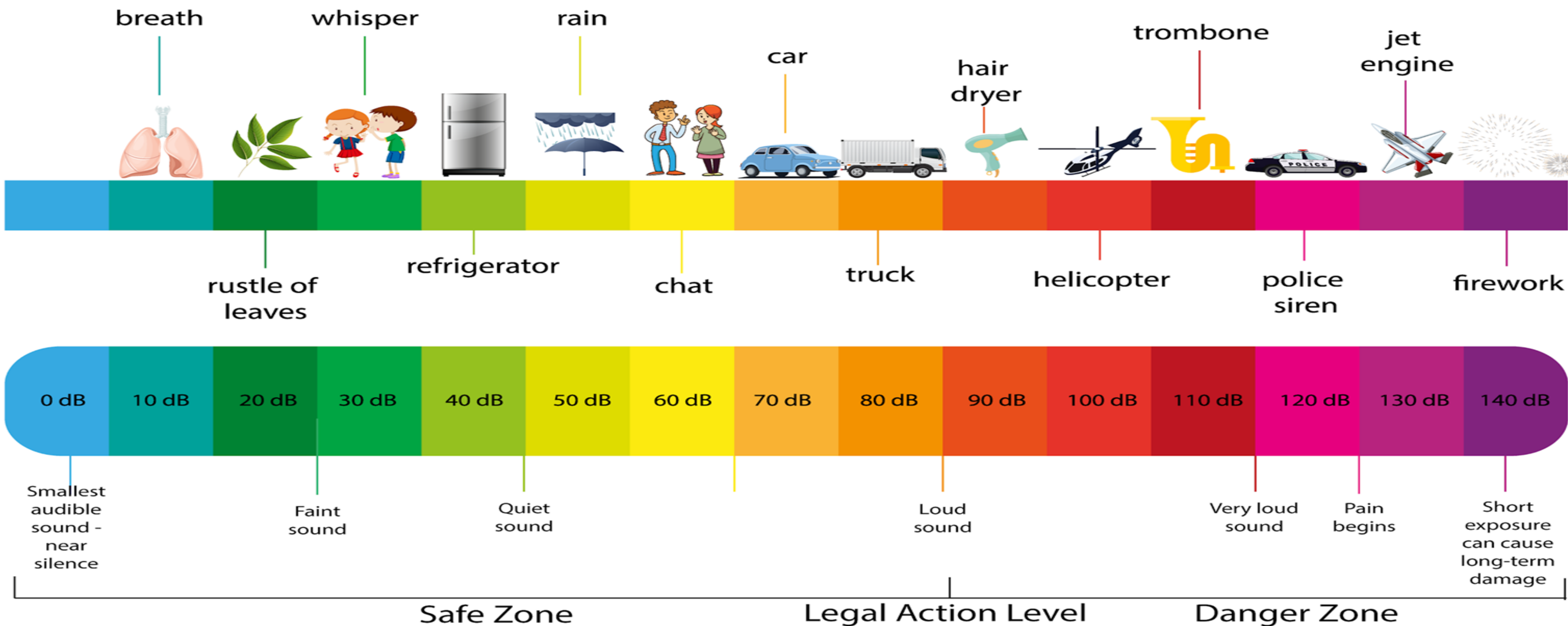
Exploring Health Impacts of Noise Exposure

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Figures



Results

A review of the literature revealed multiple lines of evidence supporting a bidirectional relationship between noise exposure and pain perception:

- **Early Studies**
 - A 1960 study on “sound analgesia” in dental procedures found that **sound alone was fully effective in relieving pain in 65%** of patients and **partially effective in 25%**. Across 5,000 procedures, sound-based pain relief was sufficient in **90% of cases**, suggesting interaction between auditory and pain pathways at the level of the **reticular formation and thalamus**.
- **Noise and Pain Thresholds (2001)**
 - Exposure to 90 dB white noise bursts caused a **20% increase in pain thresholds in women** and a **17% decrease in men**, indicating sex-dependent modulation of pain by noise.
- **Music Therapy (2002–2014)**
 - Music interventions led to **30% reductions in pain scores**, **60% lower anxiety**, and improved functional mobility in fibromyalgia patients, possibly via **dopamine and endogenous opioid activation** in the **mesocorticolimbic pathway**.
- **Clinical Settings and Environmental Noise (2020–2024)**
 - ICU and postoperative ward noise levels frequently exceeded WHO guidelines, correlating with:
 - **Higher pain scores and analgesic use** in noisier environments.
 - **Worse sleep quality** (e.g., RCSQ: 25.1 ± 13.17) and increased anxiety.
 - Shared hospital rooms had higher dB levels and **greater incidence of moderate-to-severe pain (25.6% vs. 11.0%)** compared to single rooms.
- **Mechanistic Insights (2020–2022)**
 - Moderate noise (~90 dB) activated **endogenous opioids**, producing analgesia, while **high-intensity noise (>120 dB)** triggered **neuroinflammation** and **pain sensitization**.
 - Sound-induced analgesia was confirmed via **optogenetic inhibition** of corticothalamic pathways, suggesting a direct role of sound in pain modulation independent of anxiety or opioid mechanisms.

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Conclusion

Noise exposure plays a complex and significant role in pain perception, with effects varying based on intensity, duration, and context. Evidence from both historical and contemporary studies demonstrates that sound can modulate pain through neural, hormonal, and behavioral pathways. Moderate-level sound may reduce pain via endogenous opioids and corticothalamic circuits, while high-intensity or chronic noise exposure can heighten pain sensitivity through stress, sleep disruption, and neuroinflammatory mechanisms.

These findings underscore the need to recognize environmental noise as a modifiable factor in pain management—particularly in clinical settings where patients may be vulnerable to both sensory overload and inadequate pain control. Future research should further delineate the mechanisms of noise-induced pain modulation and evaluate targeted interventions, such as acoustic therapies and environmental noise control, to enhance patient outcomes.

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