

About the relationship between ship noise and the occurrence of arterial hypertension in seafarers

Dominique Jégaden¹, David Lucas^{1, 2}

¹French Society for Maritime Medicine, Faculty of Medicine and Health Sciences, University of Western Brittany, Brest, France

²Centre for Professional and Environmental Pathologies, Morvan Teaching Hospital (CHRU), Brest, France

For more than 40 years, the relationship between noise exposure and the onset of high blood pressure is a controversial topic. The increased number of studies, reviews and meta-analyses on this subject highlights its relevance for public health. Indeed, noise is a ubiquitous stressor, and high blood pressure is a potentially life threatening disease.

A German team – Bolm-Audorff et al. [1] has just published in the ‘International Journal of Environmental Research and Public Health’, in August 2020, a new meta-analysis on this subject (“Occupational noise and hypertension risk: A systematic review and meta-analysis”). They provide a clear evidence of relationship between exposure to industrial noise above 85 dB (A) and the risk of high blood pressure (odds ratio: 1.72 [1.48–2.01]). Out of 4,583 papers collected from international databases, they selected 180 eligible articles, and finally 23 articles were included in the meta-analysis. Surprisingly, one of the 23 selected papers is one of ours, published in 1986 in the French journal ‘Archives des Maladies Professionnelles’ [2]. In this study, we recruited 455 seafarers, all men aged from 40 to 55 years (164 engine room personnel and 291 deck crew). Toward the notch at 4000 Hz on audiometry, typical of hearing loss due to noise greater than 85 dB (A), we characterised impact of noise between these two seafarers’ subgroups. This notch was not found among deck crew [3]. We calculated a prevalence of confirmed hypertension of 18.90% (12.8–25%) and 11.68% (7.92–15.44%) among engine room personnel and deck crew, respectively ($p < 0.05$). No statistical relation between hearing loss’ level and hypertension was found. This risk was independent of other known risk factors of hypertension (obesity, alcoholism, hypertensive heredity). Moreover, we noticed in our results that the occurrence of hypertension was linked, on the one hand, to a high level of noise (> 85 dB [A]) and, on the other hand, to a long duration of exposure to noise

(greater than 20 years). Several other recent meta-analyses have also the same conclusion on a positive relationship between noise and hypertension [4–7]. Fu et al. [4] found a relative risk at 1.62 (1.40–1.88) and Skogstad et al. [5] at 1.68 (1.10–2.57), the same as ours.

The inclusion of our 40-year-old work in this recent meta-analysis, underlined some facts and questions:

1. The maritime environment is unique. It could be considered as an *in vivo* laboratory, allowing us to study the reactions of the human being exposed to physical constraints such as noise and vibrations, psychological constraints (stress, confinement, isolation, boredom), and still to infections in confined spaces, as we saw recently with the COVID-19 pandemic.
2. Few studies on arterial blood pressure and noise exposure were published in seafarers’ population. In their article on hypertension in Danish seamen, Tu and Jepsen [8] underlined this risk factor (“Measured noise levels are highest in the engine rooms, followed by the levels on deck. This may partly explain the high prevalence of hypertension for seafarers working in these two areas”). Oldenburg et al. [9, 10] noted that “particularly engine room officers and galley/operating staff are at a higher coronary risk”, without mentioning a possible relationship with noise.
3. It should suggest that technological advances on noise exposure prevention on board ships are significant for 40 years (improvement of the insulation of living areas, automation of machines, soundproofed surveillance rooms, diesel-electric propulsion...) and therefore that seamen are today less exposed. Reducing occupational noise exposure have effect on health status such as deafness or, as regards this letter, hypertension is expected. However, several recent studies corroborate that engine room workers are

still exposed to harmful noise levels, above 85 dB (A), even today [11–13].

Turan et al. [14] consider that ships easily meet the International Maritime Organisation criteria, while people working on board such ships are still likely exposed to high noise levels [14]. The International Maritime Organisation noise code should therefore be updated in order to enforce lower noise levels on ships. The negative effects of noise exposure on human health are now well-known and many design solutions are now available to reduce noise levels.

4. We must also be careful on fishermen. Many of fishing vessels are still very noisy, and remember that this risk factor is added to many other risks of hypertension, such as obesity, sedentary lifestyle and alcoholism [15–17].

REFERENCES

1. Bolm-Audorff U, Hegewald J, Pretzsch A, et al. Occupational noise and hypertension risk: a systematic review and meta-analysis. *Int J Environ Res Public Health*. 2020; 17(17), doi: [10.3390/ijerph17176281](https://doi.org/10.3390/ijerph17176281), indexed in Pubmed: [32872306](https://pubmed.ncbi.nlm.nih.gov/32872306/).
2. Jégaden D, Le Fluart C, Marie Y, et al. Contribution to the study noise-high blood pressure. Concerning 455 merchant sailors aged 40–55 years. (Contribution – l'étude de la relation bruit-hypertension artérielle. – propos de 455 marins de commerce âgés de 40 – 55 ans). *Arch Mal Prof*. 1986; 47: 15–20.
3. Jégaden D. Noise on board ships: its impact on the hearing function of merchant seamen (Bruit – bord des navires: son retentissement sur la fonction auditive des marins de commerce). *Arch Mal Prof*. 1984; 45(5): 345–349.
4. Fu W, Wang C, Zou Li, et al. Association between exposure to noise and risk of hypertension: a meta-analysis of observational epidemiological studies. *J Hypertens*. 2017; 35(12): 2358–2366, doi: [10.1097/HJH.0000000000001504](https://doi.org/10.1097/HJH.0000000000001504), indexed in Pubmed: [28806352](https://pubmed.ncbi.nlm.nih.gov/28806352/).
5. Skogstad M, Johannessen HA, Tynes T, et al. Occupational noise exposure and hearing: a systematic review. *Int Arch Occup Environ Health*. 2016; 89(3): 351–372, doi: [10.1007/s00420-015-1083-5](https://doi.org/10.1007/s00420-015-1083-5), indexed in Pubmed: [26249711](https://pubmed.ncbi.nlm.nih.gov/26249711/).
6. Yang Ye, Zhang E, Zhang J, et al. Relationship between occupational noise exposure and the risk factors of cardiovascular disease in China: a meta-analysis. *Medicine (Baltimore)*. 2018; 97(30): e11720, doi: [10.1097/MD.00000000000011720](https://doi.org/10.1097/MD.00000000000011720), indexed in Pubmed: [30045338](https://pubmed.ncbi.nlm.nih.gov/30045338/).
7. Pyko A, Lind T, Mitkovskaya N, et al. Transportation noise and incidence of hypertension. *Int J Hyg Environ Health*. 2018; 221(8): 1133–1141, doi: [10.1016/j.ijheh.2018.06.005](https://doi.org/10.1016/j.ijheh.2018.06.005), indexed in Pubmed: [30078646](https://pubmed.ncbi.nlm.nih.gov/30078646/).
8. Tu M, Jepsen JR. Hypertension among Danish seafarers. *Int Marit Health*. 2016; 67(4): 196–204, doi: [10.5603/IMH.2016.0037](https://doi.org/10.5603/IMH.2016.0037), indexed in Pubmed: [28009392](https://pubmed.ncbi.nlm.nih.gov/28009392/).
9. Oldenburg M, Jensen HJ, Latza U, et al. Coronary risks among seafarers aboard German-flagged ships. *Int Arch Occup Environ Health*. 2008; 81(6): 735–741, doi: [10.1007/s00420-007-0261-5](https://doi.org/10.1007/s00420-007-0261-5), indexed in Pubmed: [17909838](https://pubmed.ncbi.nlm.nih.gov/17909838/).
10. Oldenburg M. Risk of cardiovascular diseases in seafarers. *Int Marit Health*. 2014; 65(2): 53–57, doi: [10.5603/IMH.2014.0012](https://doi.org/10.5603/IMH.2014.0012), indexed in Pubmed: [25231325](https://pubmed.ncbi.nlm.nih.gov/25231325/).
11. Nikolic A, Nikolic E. Controlling risk due to noise on ferry boat. *PROMET - Traffic&Transportation*. 2013; 25(4): 387–394, doi: [10.7307/ptt.v25i4.305](https://doi.org/10.7307/ptt.v25i4.305).
12. Borelli D., Schenone C. Seafarers' week exposure to tonal noise components. 23rd International Congress on Sound and Vibration, Athens (Greece), 10-14 July 2016.
13. Oldenburg M, Felten C, Hedtmann J, et al. Physical influences on seafarers are different during their voyage episodes of port stay, river passage and sea passage: A maritime field study. *PLoS One*. 2020; 15(4): e0231309, doi: [10.1371/journal.pone.0231309](https://doi.org/10.1371/journal.pone.0231309), indexed in Pubmed: [32267889](https://pubmed.ncbi.nlm.nih.gov/32267889/).
14. Turan O, Helvacioğlu IH, Insel M, et al. Crew noise exposure on board ships and comparative study of applicable standards. *Ships Offshore Structures*. 2011; 6(4): 323–338, doi: [10.1080/17445302.2010.514716](https://doi.org/10.1080/17445302.2010.514716).
15. Zytoon M. Occupational noise exposure of fishermen aboard small and medium-scale fishing vessels. *Int J Ind Ergon*. 2013; 43(6): 487–494, doi: [10.1016/j.ergon.2012.08.001](https://doi.org/10.1016/j.ergon.2012.08.001).
16. Levin J, Curry W, Shepherd S, et al. Hearing loss and noise exposure among commercial fishermen in the gulf coast. *J Occupat Environ Med*. 2016; 58(3): 306–313, doi: [10.1097/jom.0000000000000642](https://doi.org/10.1097/jom.0000000000000642).
17. Nguyen N. Noise exposure and its relationship with hypertension among fishermen in Thua Thien-Hue Province, Vietnam. *J Integrat Com Health*. 2020; 09(01): 3–16, doi: [10.24321/2319.9113.202001](https://doi.org/10.24321/2319.9113.202001).