OCCUPATIONAL NOISE EXPOSURE – RISK FACTOR FOR SEAFARERS

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Abstract: Introduction: Professional exposure to noise higher than 85 dB can lead to hearing diseases (hypoacusia, professional deafness through sound trauma) but, in the same time, also to diseases related to profession (high blood pressure, digestive diseases, neuroses). The measured values of sound intensity within vessel compartments (engine room, main deck) are different with a higher level in the engine compartment (LEX, 8h = 85 dB(A)). Material and method: The survey concerns a batch of 90 navigators (deck and engine crew), selected according to the level of exposure to noise and length of service on the basis of an anamnestic questionnaire that applies to the persons exposed to noise and vibration.

Keywords: noise, seafarers, occupational noise, limit exposure level (LEX, 8h), hearing impairment

INTRODUCTION
Over the last fifteen years, the incidence of hearing defects as the main reason for failure has increased among the seafarers, especially the engine crew.

The aim of the study was to correlate the level of hearing impairment with the intensity of noise for seafarers, on different types of merchant ships of 4 types (oil, container, RO-RO and general cargo), during routine sea voyages, taking in consideration that occupational noise is the most common cause of noise-induced hearing loss in adults.

According to International Standard Organization (ISO), professional noise is defined as a complex of sounds with various intensities and heights, with different, rhytmical or arhythmatic characteristics, produced continuously or discontinuously, by machines, instruments, devices or human voice, during professional activity.

Particularities of occupational stress to the seafarers are in accordance with the work environment (different for those working at engines and those dealing with navigation on board of the vessels), exposure to intense noise and vibration, associated with periodicity and duration of embarkments, length of service and the actual working time on board of marine vessels.

MATERIAL AND METHOD
This study concerns a batch of subjects (seafarers) that work on board of the vessels, selected according to the level exposure to noise, vibration and length of service on the basis of an anamnestic questionnaire that applies to all persons exposed to noise and vibration.

Risk factors have been studied: exposure to professional emissions, pathological case history related to disorders at the level of the middle ear and administration of toxic medication, neuropsychical symptomatology and subjective tolerance to noise.

Measurements were carried out using the sound level meter NL21 – Rion Japan, coupled with the frequency analyser at 1/1 and 1/3 octave for the frequency field 12,5 Hz – 10 KHz, with a homologation certificate as per EEC Model which is valid in Romania according to HG 1055/2001.

Noise level was measured on board of four types of vessels within commercial marine (general cargo, container, RO-RO, oil tank) during voyages at sea and values that exceeded 87 dB (A) in some of the vessels compartments were registered.

The survey was carried out on a batch of 90 seafarers (deck and engine crew) attention being paid to: medical history, length of service, actual working time on board of vessels, occupational noise exposure, other occupational exposures, use of hearing protection, periodicity of embarkation and shifts.

Prophylactic medical examinations carried out at the beginning and the end of voyages consisted in: general clinical examinations paying special attention to the cardiovascular system, psychological examination, ear examination and liminal tonal audiometry, by using Amplaid A315
audiometer for tonal frequencies between 125 Hz – 12 KHz. Professional hearing impairment is defined as the permanent drop of the sound threshold at a frequency of 4000 Hz, after applying the presbyacusia correction.

RESULTS AND DISCUSSIONS

The structure of the batch was: 45 subjects representing the deck navigating personnel and 45 subjects representing the engine crew with the following distribution on age groups: deck crew – 7 cases under 35 years, 15 cases between 35 and 40 years, 20 cases between 40 and 45 years, and 3 cases over 45 years old (average 40.45 ± 5.53 years old); engine crew - 8 cases under 35 years, 12 cases between 35 and 40 years, 17 cases between 40 and 45 years, and 8 cases over 45 years old (average 40.563 ± 7.12 years old) (Table I, Figure 1).

Table I: Case distribution depending on age

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Deck crew</th>
<th>Engine crew</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;35</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>35-40</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>40-45</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>&gt;45</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

Distribution of the cases according to length of service groups is the following: deck crew - 3 cases (6.67%) under 10 years, 20 navigators (44.44%) with a length of service between 10 to 15 years, 20 seafarers (44.44%) with a length of service between 10 and 15 years, 15 cases (33.33%) between 15 and 20 years, and 5 cases (11.11%) with a length of service between 20 and 25 years and no case with a length of service more than 25 years (Table II, Figure 2).

Table II: Case distribution depending on work length

<table>
<thead>
<tr>
<th>Work length (years)</th>
<th>Deck crew</th>
<th>Engine crew</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>3 (6.67%)</td>
<td>5 (11.11%)</td>
</tr>
<tr>
<td>10-15</td>
<td>20 (44.44%)</td>
<td>20 (44.44%)</td>
</tr>
<tr>
<td>15-20</td>
<td>20 (44.44%)</td>
<td>15 (33.33%)</td>
</tr>
<tr>
<td>20-25</td>
<td>2 (4.44%)</td>
<td>5 (11.11%)</td>
</tr>
<tr>
<td>&gt;25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>45 (100%)</td>
<td>45 (100%)</td>
</tr>
</tbody>
</table>

High levels of ambient noise, typically above 85 dBA cause noise-induced hearing loss (NIHL). The negative effects of such levels of noise and higher, depend upon individual physiology and the duration of exposure. [9]

The etiological factors that favour the development of hypoacusia are: age, length of service and the actual working time on board of the vessels, pre-existing disorders of the middle ear and ototoxic treatment, alcoholism, smoking, fatigue of the acoustic reflex, toxic emissions. The average exposure duration until the development of the professional hearing disease is of 15 years. [2, 3, 5, 8]. The associated risk factors that have been studied are represented in Table III and figure 3.

Figure 1. Case distribution depending on age

Figure 2. Case distribution according to length of service

Figure 3. Case distribution according to age
Table III: Associated risk factors

<table>
<thead>
<tr>
<th></th>
<th>Deck crew</th>
<th>Engine crew</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular disorders</td>
<td>4 (8.88%)</td>
<td>6 (13.33%)</td>
</tr>
<tr>
<td>Hearing disorders</td>
<td>1 (2.22%)</td>
<td>3 (6.67%)</td>
</tr>
<tr>
<td>Ototoxic treatments</td>
<td>-</td>
<td>1 (2.22%)</td>
</tr>
<tr>
<td>Smoking</td>
<td>38 (84.44%)</td>
<td>41 (91.1%)</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>23 (51.1%)</td>
<td>28 (62.2%)</td>
</tr>
</tbody>
</table>

Simultaneous exposure of the navigating personnel to vibrations and noise allows the coexistence of hearing changes and vibration disease, especially when no means of sound protection are used. [1, 2, 7]

Figure 3. Associated risk factors

The noise level measured on board of the vessels varies (engine more than 85 dB, deck command less than 85 dB, repose areas less than 70 dB). The values of the noise registered with the sound level meter on board of the vessels are displayed in figure 4.

Figure 4. Noise levels registered on board of the marine vessels

Professional hypoacusia is defined as the permanent drop of the sound threshold at a frequency of 4000 Hz [4, jegaden], with over 30 dB including, after applying the presbiacusia correction. It is a perception type hypoacusia, generally bilateral and symmetrical, with no interest in conversational frequencies, of professional etiology.[4]

Audiometric determinations carried out at the beginning and the end of voyages showed that hearing changes is dominant in the band of 3000 – 6000 Hz octave [4,9]: 53.33% (24 cases) of the total number of navigators that were part of the engine crew showed light hypoacusia, in comparison to 28.9% (13 cases) of the total number of the navigators that were part of the deck – command crew; 15.55% (7 cases) of the navigators within the engines showed bilateral hypoacusia while at the deck level no case was identified; 2 cases (4.44%) of severe hypoacusia among the engine crew and no cases among the deck seafarers; 15.55% (7 cases) of the total engine crew showed medium hypoacusia; 4.44% (2 cases) out of the deck navigators also showed the same type of hypoacusia; 66.7% (30 cases) out of the investigated deck crew showed normal hearing, while only 11.11% (5 cases) out of the engine crew showed normal hearing. (figures 5, 6).

Figure 5. Correlations between work length and hearing changes

Figure 6. Audiometric determinations

Our study showed a significant difference in the incidence of noise-induced hearing loss between deck and engine crew, also in correlation with the
CONCLUSION
Regulate exposures to noise greater than 85dBA represents a permanent professional risk for the seaferars; The measured values of sound intensity within vessel compartments (engine room, main deck) are different with a higher level in the engine compartment, requiring sound protection equipments; Audiometrical determinations carried out at the beginnig and the end of voyages showed that hearing changes were significant especially among engine crew.

BIBLIOGRAPHY