Non Occupational Noise - Sources, Exposure, and Effects on Hearing

Based on Doctoral thesis of Jaana Jokitulppo

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We need hearing for

- Communication
- Work
- Recognising important sounds
- Enjoyment, entertainment
- Experience of silence
Noise increases continuously

• Reasons
  - Traffic growth, industrialisation
  - Technical development

• Contribution of:
  - Economical well being
  - More spare time
  - Variation of activities
  - Modern people eager to have experiences
Effect of Noise

- Irritation, annoyance, effects on sleep, headache, stress responses
- Hyperacusia: Communication difficulties, social isolation
- Effects on personality and behavior
- Voice problems
- Increase of heart rate, blood pressure, hormone responses
- Risk for accidents
- Effects on Hearing, TTS, tinnitus, Sound distortion

Concentration, motivation, learning, language development
Why evaluation of noise exposure is important?

- Development of NIHL is gradual
  - Longitudinal and non-reversible process
  - Harmful effects of noise is often too late noticed
  - Tinnitus effects more and more on quality of life
  - Effects on individuals life, social environment and activities

- Need for communication is important
  - Speaking the most significant way to communicate (fast, effectiveness)
  - Many jobs have changed to communication work & good hearing is needed

- Occupational noise exposure continuously problem
  - Diagnosed NIHL about 1000/year in Finland

- On safety more and more important
Why evaluation of leisure time noise exposure is important?

- Noise exposure starts early at childhood
- The total noise exposure of all the leisure time activities combined is less known
- Noisy leisure time may have effect on total noise exposure
  - Appearance of Occupational NIHL faster
  - Hearing loss or tinnitus can interfere the work or even prohibit the work (e.g. musicians, acousticians)
  - Also the vocational selection (need for good hearing capacity)
- Good health important value of life
- Ignorance of effect of noise is general
Leisure time noise?

= Any high sound level performed during the leisure time activities. Examples of sources:

- **Music**
  - Discos, pubs, restaurants, concerts, festivals
  - Listening: audio systems (car, home), portable equipment: Mp3, I-pod
  - Playing: practising, performing, band/orchestra

- **Home tools, and equipment indoors and outdoors**

- **Sports**
  - Sports games, (often strong music included)
  - Shooting, hunting
  - Motor sports: driving, games, events

- **Fireworks, toys, games, movies**
Noise levels of different activities, $L_{Aeq}$, dB

- Playing in a band/orchestra 75-135
- Musical instruments 60-122
- Singing 75-105
- Listening to home stereos 70-100
- Listening via car audio systems 65-100
- Portable music equipment (Mp3) 50-120
- Concerts, festivals, music events 73-110
- Aerobics 78-106
- Movies 70-85
- Discos, music bars 60-110
- Motor sports 70-115
- Shooting (hunting) 120-165 $L_{peak}$
- Fireworks 120-165 $L_{peak}$
- Machines and equipment at home 60-100
- Tools, and machines outdoors 70-110
- Toys, games 70-112
Volley Ball game Finland
2010, $L_{Aeq}=92$ dB
Toys can also be noisy

- Toy weapons (impulse noise) 132-170
- Toy weapons (continuous noise) 82-99
- Cars, other moving vehicles 80-102
- Toy tools 94-109
- Phones, mobile phones 82-94
- Simulators 81-100
- Games 81-104
- Soft toys 81-100
- Bicycle horns 92-112
- Key chains 73-80
Study gives the answers

What is the Finnish people’s total risk for hearing loss related to leisure time noise exposure during the lifetime?

- How much time is spend weekly on leisure time activities?
- What are those activities, which have most effect on total leisure time noise exposure?
- What is the total leisure time noise exposure of all the activities combined?

What are the effects of personal noise exposure on self-reported auditory symptoms?

What are the thresholds of Finnish conscripts before and after the military service?
How the noise exposure was calculated and evaluated?

- According to Occupational noise exposure legislation
  - EU directive 10, 2003 (National legislation VnA 85,2006)
  - Lower and upper action levels 80 dB, 85 dB, (limit value 87 dB)
  - Was calculated with weekly noise exposure according to \(L_{Aeq,40h}\), ISO 1999

- With Questionnaire
  - Self reported duration of exposure of activity (hours)
  - Subjective estimation of loudness Scale 1-5 (60-100 dB)
  - Hearing Symptoms
  - Audiograms (conscripts)
Study co-operation

- The Finnish Federation of Hard of Hearing (FFHOH)
- National Institute for Health and Welfare (THL) part of the EXPOLIS-study
- The Finnish Defence Forces (Porin Prikaati, SOTLK)
Study subjects

- Teenagers 12-16 years
- Conscripts 19-27 years
  - Pori Brigade
  - Arrive and leaving examination
- Adults 25-55 years
  - Helsinki area
  - EXPOLIS-study
Results 1

• One of five was exposed over 85 dB leisure time noise at their life time
  ▫ Teenagers and young adults used 40-hrs/week at their noisy leisure time, adults about n. 25-30 hrs/week
  ▫ Weekly noise exposure was gathered many activities, the most significant were:
    • Music bars & discos, concerts, shooting, playing in a band, home tools and motor sports

• Safety level for ears, under 75 dB
  - 20% of teenagers
  - 30% of 19-40 years olds
  - About half of over 40- year olds
Weekly noise exposure among all age groups

- weekly noise exposure over 85 dB
- weekly noise exposure over 80 dB
- weekly noise exposure over 75 dB

<table>
<thead>
<tr>
<th>Age Group</th>
<th>% of people exposed</th>
</tr>
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<tbody>
<tr>
<td>12-16</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>56</td>
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<td>19-20</td>
<td>27</td>
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<td>25-29</td>
<td>38</td>
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<td>69</td>
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<td>30-39</td>
<td>32</td>
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<td>73</td>
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<td>40-49</td>
<td>18</td>
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<td>45</td>
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<td>50+</td>
<td>31</td>
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<td>54</td>
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<td>52</td>
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</table>
Results 2

- **Tinnitus sometimes or often**
  - Over 70% of teenagers and conscripts
  - 25% of adults

- **TTS sometimes or often**
  - About 50% of teenagers and conscripts
  - Over 10% of adults

Auditory symptoms experienced especially those with high personal weekly noise exposure.
# Weekly noise exposure and hearing symptoms - Conscripts

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Never 0</th>
<th>Sometimes 1</th>
<th>Often 2</th>
<th>Continuously 3</th>
<th>Difference</th>
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</thead>
<tbody>
<tr>
<td>Tinnitus related to noise</td>
<td>78</td>
<td>80</td>
<td>86</td>
<td>82</td>
<td>All</td>
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<tr>
<td>Tinnitus for other reason</td>
<td>79</td>
<td>81</td>
<td>84</td>
<td>87</td>
<td>All</td>
</tr>
<tr>
<td>Pain in ear</td>
<td>79</td>
<td>80</td>
<td>85</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Sound unpleasant</td>
<td>79</td>
<td>80</td>
<td>83</td>
<td>92</td>
<td>All</td>
</tr>
<tr>
<td>Sound distortion</td>
<td>79</td>
<td>81</td>
<td>85</td>
<td>93</td>
<td>All</td>
</tr>
<tr>
<td>TTS</td>
<td>78</td>
<td>81</td>
<td>84</td>
<td>95</td>
<td>All</td>
</tr>
</tbody>
</table>
Results 3

- 19% conscripts hearing loss BEFORE the military service
  - Most of them related to leisure time noise
- 27% had hearing loss at the END OF SERVICE of
  - The most effect was with less hearing protection usage rate of combat training in field
Hearing of Shooters - conscripts

Bar graph showing hearing loss percentage:
- Blue bar: Shooter
- Red bar: Non shooter

Line graph showing HL (Hearing Loss) in dB across different frequencies (500, 1000, 2000, 3000, 4000, 6000, 8000 Hz):
- Shooter, HL, right
- Shooter, HL, left
- HL, right
- HL, left
Conclusions

- The most sound exposure period seem last about 15-20 years
  - at most at the age of 25-30 years, decrease after 40 years
- Risk of hearing loss
  - 1 of 3 of teenagers and young adults (under 40 years)
  - 1 of 5 adults (over 40 years)
- A lot of time is used on noisy leisure time activities
- 1 of 5 hearing loss of Conscripts before military service
- 1 of 3 hearing loss of Conscripts after military service
- Shooters had hearing loss already before the military service
- Auditory symptoms general, especially tinnitus & TTS signals with high exposed noise levels
- Hearing protection hardly use
What should be done?

Noise levels must be reduced!!

- Legislation, especially with children hearing protection!
- Noise control (authorities, event arrangers)
  - Measurements, checking
  - Noise reduction
    - Technical opportunities (e.g. limiters)
    - Planning, design (acoustical & audio planning)
- Health examinations
  - Audiograms, hearing symptoms questionnaires
- Education
  - Into schools education systems
  - Key professionals: teachers, trainers, designers etc.
- General education
  - Hearing conservation programs, Campaigns
- Hearing protectors
  - Nice looking,
  - ->To trend.. Loosers do not used HPD’s!!!
Thank you!

THE MOST IMPORTANT THINGS ARE SAID WITH LOW VOLUME LEVEL!