



HAND-ARM VIBRATION SYNDROME IN WORKERS EXPOSED TO PROLONGED VIBRATION

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ABSTRACT:

Industrial vibrations are the cause of hand-arm vibration syndrome, characterized by a polymorphic clinical picture. The aim of the study is to improve the diagnostics, treatment and prevention of hand-arm vibration syndrome in workers. Material and methods: The object of the study are 65 cases of hand-arm vibration syndrome in workers of enterprises in Northern Bulgaria. The persons were hospitalized in the Department of Occupational Diseases, University Hospital - Pleven in the period 2019 - 2023. The group was related with a length of service of more than 5 years. Clinical, laboratory, functional, imaging and statistical methods were applied. Results and discussion: The impairments of the examined persons are expressed in four clinical syndromes: neurological, vascular, bone-joint-muscular and auditory-vestibular. Socially significant diseases were found in 91% of the examined persons. Conclusions: Hand-arm vibration syndrome is a current health problem for workers in various branches of production in Bulgaria. Damage to persons exposed to long-term (more than 5 years) vibration exposure is manifested by a variety of clinical symptoms, summarized in four main syndromes - neurological, vascular, bone-joint-muscular and auditory-vestibular. Individuals in the first to second and second stages of vibration disease predominate among the studied contingent of workers. Prolonged vibration exposure predisposes to socially significant diseases such as diabetes mellitus, coronary heart disease, arterial hypertension, etc.

Keywords: occupational diseases, vibration, hand-arm vibration syndrome,

BACKGROUND

Vibrations are mechanical oscillations of an object about an equilibrium position. [1] They are periodically repeated and characterized by different frequencies. [2] Industrial vibrations are the cause of hand-arm vibration syndrome, characterized by a polymorphic clinical picture. [3]

The accompanying unfavorable factors of the working environment (noise, cooling, muscle overstrain, toxic agents) potentiate the effect of vibrations. [4, 5]

Hand-arm vibration syndrome is the most common example of an occupational injury due to segmental vibration on the hands. [6, 7, 8] The syndrome is characterized by spasms of the digital arteries caused by vibration-induced damage of the peripheral nerve and vascular tissue, subcutaneous tissue, bones and joints of the hands and fingers. [9, 10] The pathologic process may also involve arterial muscle wall hypertrophy; demyelinating peripheral neuropathy; excess connective tissue deposition in perivascular and subcutaneous tissues; microvascular occlusion. [11, 12]

The aim of the study is to improve the diagnostics, treatment and prevention of hand-arm vibration syndrome in workers.

MATERIAL AND METHODS

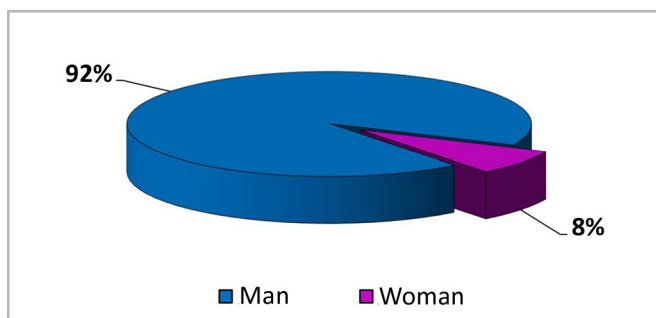
The object of the study are 65 cases of hand-arm vibration syndrome in workers of various enterprises in Northern Bulgaria. The persons were hospitalized in the Department of Occupational Diseases, University Hospital - Pleven in the period 2019 - 2023. The group was related to the action of segmental vibration, and the length of service was more than 5 years. Clinical, laboratory, functional, imaging and statistical methods were used. Treatment with medication and physical factors was carried out. All participants signed informed consent forms for the study. Specific occupational pathology methods were applied - occupational anamnesis and production characteristics; clinical methods - history of disease, somatic and neurological status, local status of upper limbs; laboratory methods - FBP, blood sugar, uric acid, samples for rheumatic activity; instrumental methods - skin thermometry, biomicroscopy of capillaries, cold provocation test,

palesthesiometry, distal Doppler sonography, radiography; computer tomography, electromyography; alternating dynamometry; audiometry.

RESULTS AND DISCUSSION

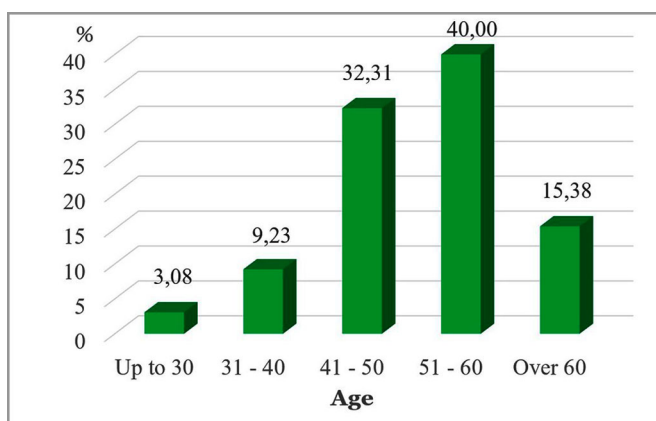
The total number of persons is 65, of which 60 are men and 5 are women. (Figure 1).

Fig. 1. Distribution of persons by gender



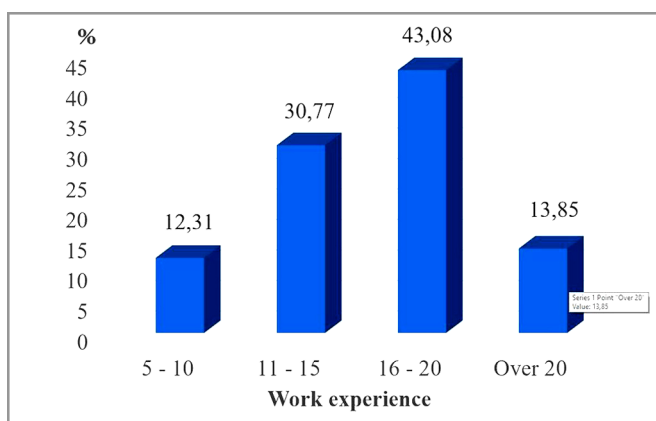
The age distribution was from 28 to 64 years, with a mean age of $50,08 \pm 4,82$ years ($n=65$) (Figure 2).

Fig. 2. Distribution of persons by age



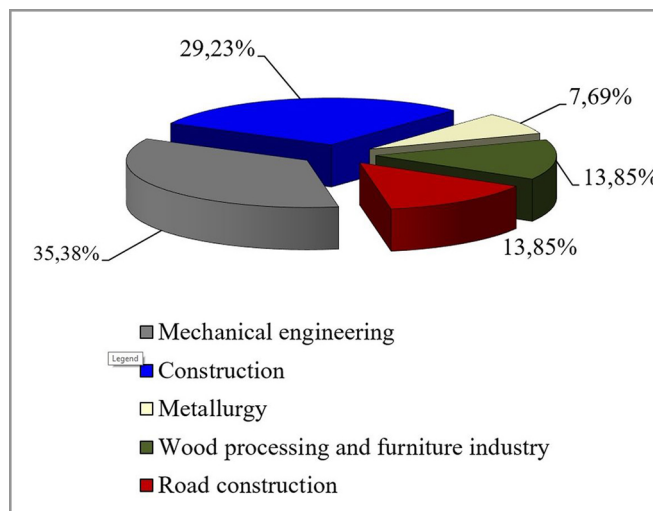
The work experience related to contact with segmental vibrations is more than 5 years (from 6 to 30 years), on average $15,94 \pm 2,62$ years ($n=65$) (Figure 3).

Fig. 3. Distribution of persons by work experience



By branches of production, the distribution is as follows (Figure 4).

Fig. 4. Distribution of persons by branches of production



Subjective complaints were present in all examined persons - pain in fingers, palms, wrists, forearms, elbow and shoulder joints; numbness in the fingers; attacks of whiteness of the fingers - Raynaud's phenomenon; coldness, sweating, swelling and stiffness of the fingers and palms; decreased hand strength and dexterity; decreased hearing.

The following clinical syndromes were developed in the examined persons:

- Vascular syndrome - localized in the distal parts of the limbs, manifested by Raynaud's phenomenon - with whiteness and numbness of phalanges or entire fingers or with cyanotic color and swelling of the fingers and palms. The indicated manifestations are observed in varying degrees of expression in all 65 examined workers.

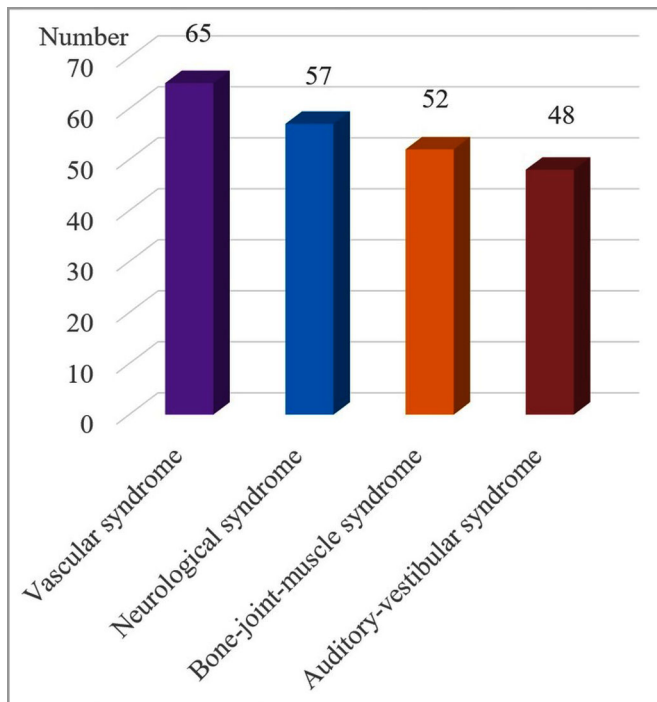
- Neurological syndrome - characterized by reduced vibration sensitivity, reduced sensitivity of the distal type for pain, temperature, touch.

Hyperhidrosis and atrophic changes are manifestations of the autonomic nervous system involvement. Additional complaints are fatigue, headache, insomnia, irritability, tightness and heaviness in the heart area. The syndrome was found in 57 people.

- Bone-joint-muscle syndrome - is expressed in damage to the musculoskeletal system of the limbs (tendomyositis, tendovaginitis, epicondylitis, shoulder peri-arthritis, etc.) and reduced muscle strength. It was observed in 52 individuals.

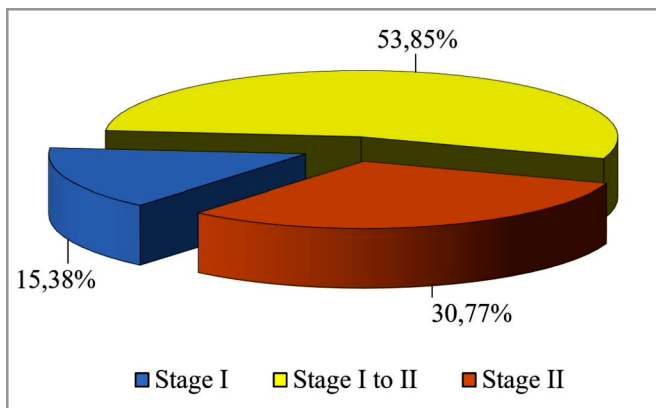
- Auditory-vestibular syndrome - characterized by reduced hearing and vestibular disorders. It is present in 48 examined persons (Figure 5).

Fig. 5. Distribution of persons by syndromes



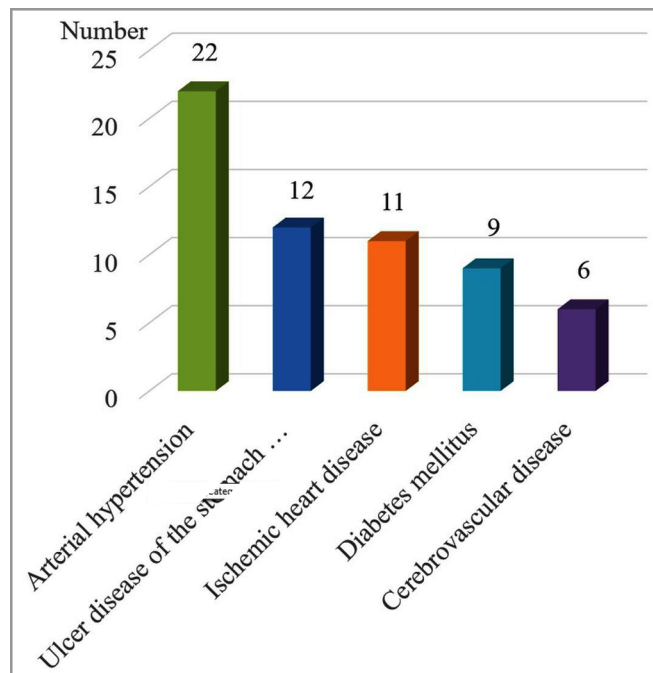
The distribution of the examined persons depending on the stage of the vibration disease is presented in Figure 6.

Fig. 6. Distribution of the examined persons depending on the stage of the vibration disease



During the clinical observation of the studied patients, accompanying socially significant diseases were registered (some subjects had more than one co-morbidity) (Figure 7).

Fig. 7. Accompanying diseases



CONCLUSIONS

- Hand-arm vibration syndrome is a current health problem for workers in a number of branches of modern production in Bulgaria.
- Damage to persons exposed to long-term (more than 5 years) segmental vibration exposure is manifested by a variety of clinical symptoms, summarized in four main syndromes - neurological, vascular, bone-joint-muscular and auditory-vestibular.
- Individuals in the first to second and second stages of vibration disease predominate among the studied contingent of workers.
- Prolonged vibration exposure predisposes to socially significant diseases such as diabetes mellitus, coronary heart disease, arterial hypertension, etc.

REFERENCES:

1. Tarnovska T. [Hygiene. Textbook for students of Dentistry and other medical specialities.] [in Bulgarian] Lax book, Plovdiv. 2021, pp.472-486.
2. Martin J, Budavölgyi A, Lászlóffy M, Kudasz F. Vibration. *OSHWIKI. EASHW*. Pub: 16/12/2013; update: 10/08/2022. [[Internet](#)]
3. Dimitrova-Toneva A, et al. Ste-nosis syndromes in case of local vi-bration impact. *Annual Proceeding (Scientific Papers) – IMAB*. 1998; 4:306-307. ISSN 1310-7232.
4. Edwards DJ, Holt GD. Hand-arm vibration exposure from construction tools: results of a field study. *Constr Manag Econ*. 2006; 24(2): 209-217. [[Crossref](#)]
5. Cooke RA, Lawson IJ. Cold in-tolerance and hand-arm vibration syn-drome. *Occup Med (Lond)*. 2022 Apr 19;72(3):152-153. [[PubMed](#)]
6. Bovenzi M, Prodi A, Mauro M. A longitudinal study of neck and up-per limb musculoskeletal disorders and alternative measures of vibration exposure. *Int Arch Occup Environ Health*. 2016 Aug;89(6):923-33. [[PubMed](#)]
7. Armstrong TJ. Chapter 32 - Me-chanical Stressors. In: Textbook of Clinical Occupational and Environ-mental medicine. 2nd edition. Rosenstok L, Cullen MR, Brodtkin CA, Redlich CA. (editors). Saunders. 2005. pp837-854. [[Crossref](#)]
8. Gemne G. Diagnostics of hand-arm system disorders in workers who use vibrating tools. *Occup Environ Med*. 1997 Feb;54(2):90-95. [[Crossref](#)]
9. Lawson I, Burke F, McGeoch K, Nilsson T, Proud G. Hand-arm vibra-tion syndrome. In: Hunter's Diseases of Occupations. Edited by: Baxter P, Aw TC, Cockcroft A, Durrington P, Harrington JM. 10th Edition. CRC Press, London. 2010, pp. 489–512. [[Crossref](#)]
10. Pelmear P, Wasserman D. Hand-arm vibration. Second ed: OEM Press Beverly Farms, MA; 1998. p. 1–272.
11. Nilsson T, Wahlström J, Burström L. Hand-arm vibration and the risk of vascular and neurological diseases-A systematic review and meta-analysis. *PloS One*. 2017 Jul 13;12(7):e0180795. [[PubMed](#)]
12. Tekavec E, Nilsson T, Dahlin LB, Axmon A, Nordander C, Riddar J, et al. Biomarkers in Patients with Hand-Arm Vibration Injury Entailing Raynaud's Phenomenon and Cold Sensitivity, Compared to Referents. *Proceedings*. 2023; 86(1):27. [[Crossref](#)]

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