

A Review on the Vibration Exposure Limits in Korea

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Objective: The objective of this study is to review the exposure limits in the legislation, guidelines, and standards for human vibration in Korea.

Background: There have been relatively less interests in vibration than other risk factors in Korea. However, the importance of vibration is increasing as industry and everyday life are more mechanized.

Method: Various enforcements were examined including legislation, guidelines, and standards for whole-body vibration and localized vibration.

Results: No exposure limits were found in legislation, guidelines, and standards for the human vibration in Korea.

Conclusion: It is important to introduce new duties regarding vibration risks to the general duties. Further studies are expected on the vibration exposure limits appropriate for Korean people and job conditions.

Application: The results from this study would be of help to induce more interests in human vibration to the occupational health and safety professionals of Korea.

Keywords: Vibration, Exposure limit, Legislation, Guideline, KS

1. Introduction

Vibration affecting human body can be divided into whole-body vibration and localized vibration. Whole-body vibration is known to induce lumbar pain, the disorders of digestive organs or reproduction organs and nervous system change. In addition, whole-body vibration may affect discomfort and activity interruptions. A typical effect of localized vibration effects is the vibration white finger. Its main symptom is that blood flow is reduced by contraction of blood vessels of the hands and fingers. As a result, the hands or fingers become pale and numb like sticking with a needle, and pain is severe (Mansfield, 2005).

Vibration is regarded as one of the risk factors of musculoskeletal disorders. The development of musculoskeletal disorders can be aggravated by psychological stress added to upper extremities together with repetitive movement, awkward posture and excessive muscular demand, when one works using power tools.

Health impairment, due to vibration, occurs, when one is exposed to excessive level

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of vibration for the long-term. The treatment of diseases occurring by vibration is not easy, and there are not many cases of full recovery. Therefore, prevention of diseases caused by vibration is one of the best ways. However, people cannot completely avoid vibration in industry and everyday life in this mechanization age. In this regard, it is necessary to present the appropriate exposure limits of vibration suitable for Korean people's human body conditions and working conditions.

The preceding study of Kim et al. (2013) investigated developed countries' regulations on human vibration. This paper examined Korea's exposure limits to whole-body vibration and localized vibration through recently-revised occupational disease researches, judgment standards, guidelines and standards. Furthermore, this paper discussed the parts additionally requiring regulations and researches in Korea.

2. Guideline for Occupational Diseases

According to the Industrial Accidents Compensation and Insurance Act, an occupational accident refers to worker's injury, disease, impairment or death, in occupations. Diseases on duty are divided into occupational diseases, diseases by disaster and other diseases. A disease on duty refers to a disease caused by handling the factors that may cause worker's health impairment such as physical elements, chemical materials, dust, pathogen and work giving burden to human body, or a disease caused by being exposed to them (MOEL, 2012).

Because there are many cases that have difficulties to prove causal relationship between work and disease, due to the lack of medical and scientific knowledge, such a problem is solved through the recognition standards of diseases in the Industrial Accidents Compensation and Insurance Act.

Musculoskeletal disorders belong to the category of occupational diseases, and the Enforcement Ordinance of the Industrial Accidents Compensation and Insurance Act defines musculoskeletal disorders as the disorders burdened to musculoskeletal system by period engaged in the job, workload and strength, job performing posture and speed and workplace structure. The ordinance also specifies the work done in the state of many repetitive motions, work using excessive force, work maintaining improper posture, vibration work and other work done giving burden to specific human body part. When judging the job relevance of human body-burdening work, the degree of burden to human body, job sequence, whether there are noncontinuous tasks, whether there are nonstandard tasks, period engaged in the job, and disease status should be comprehensively considered for judgment. The degree of burden to human body needs to be judged by evaluating through listening to relevant experts' opinions including ergonomics experts, industrial hygienic experts and industrial medical experts, and accident investigation should be conducted together with those experts, if necessary.

In deciding whether a disease caused in musculoskeletal system is recognized as a disease on duty, the Korea Workers' Compensation and Welfare Service recently revised and enforced the Investigation and Judgment Guidelines of Musculoskeletal Diseases on Duty that set forth how to judge and an investigation method to ensure fairness and objectivity on January 2015 (KCOMWEL, 2015). The guidelines describe representative musculoskeletal disorders and risk factors by human body part, recognition standards and judgment method, investigation method of work giving burden to human body and investigation and judgment procedures in details. The vibration is regarded as a risk factor in the guidelines. The guidelines let relevant people write average daily working hours by categorizing the status of vibration existence for localized vibration, and categorizing vibration causes for whole-body vibration. However, safe vibration limits are not presented.

3. Legislation

The laws related to vibration include the Environmental Policy Act, Sound and Vibration Control Act and Act on Test and Inspection

of Environment, and all these stipulate whole-body vibration. The act directly related with exposure limit is the Sound and Vibration Control Act, which divides the sources of sound and vibration into everyday life environment, traffic, factory and airplane, and the act focuses more on sound, rather than vibration (MOE, 2015). Table 1 exemplifies exposure limits related to everyday life environment, and Table 2 exemplifies the exposure limits of factory vibration.

Table 1. Exposure limits of vibration in everyday life (unit: dB(v))

Source	Day (06:00 ~ 22:00)	Night (22:00 ~ 06:00)
Residential area, green area, resort area, natural environment conservation area, school, general hospital, public library	Below 65	Below 60
Others	Below 70	Below 65

Table 2. Exposure limits of vibration in factory (unit: dB(v))

Source	Day (06:00 ~ 22:00)	Night (22:00 ~ 06:00)
Residential area, green area, housing development promotion zone, resort development promotion zone, natural environment conservation area	Below 60	Below 55
Semi-residential area of urban areas, agriculture area, marine resource protection zone	Below 65	Below 60
Commercial area and semi-industry zone, industrial development promotion zone	Below 70	Below 65
General industrial and private industrial area	Below 75	Below 70

Regarding localized vibration, the Industrial Safety and Health Law sets forth business owner's obligations on health actions and health diagnosis on vibration. Its enforcement ordinance specifies the proper allocation of proper working hours and break time (MOEL, 2015). Chapter 4 of the Industrial Safety and Health Enforcement Regulation defines vibration work (work using rock drill, power hammer, chain saw, engine cutter, power grinder, impact wrench and other machines and tools that may cause health impairment, due to vibration). The regulation also sets forth vibration protection gear, the reminding of hazard, placing manuals of vibration machines and tools, and management of vibration machines and tools; however, specific exposure standards have yet to be presented. Although, Chapter 12 of the regulation refers to vibration as a cause of musculoskeletal disorders, specific hazard has not been specified.

4. Guidelines

The guidelines related to human vibration in Korea are enacted and proclaimed by the Korea Occupational Safety and Health Agency. Such guidelines (KOSHA Code) are just recommendations without forcibleness, and these are professional technical guidelines that referred to overseas' technical data mostly.

Concerning the guidelines directly related with the exposure standards of whole-body vibration, there are Safety Technology

Guidelines (G-111-2014) on risk reduction of whole-body vibration for agricultural machine work and Guidelines on Lumbar Pain Risk (M-68-2012). The guidelines related with localized vibration include Localized Vibration Measurement and Evaluation Guidelines (H-77-2012) and Technical Guidelines on Hand and Arm Vibration Control (M-31-2012).

Especially, the Localized Vibration Measurement and Evaluation Guidelines set forth the definition of localized vibration, factors affecting localized vibration measurement and evaluation, localized vibration measurement and evaluation and daily exposure recommendation standards on localized vibration, and stipulates not to exceed 5.0m/s^2 , based on eight hours of working house a day (KOSHA, 2012).

5. KS Standards

The KS Standards have translated the guidelines of ISO (International Organization for Standardization), and the standard related with the exposure standards of whole-body vibration is KS B ISO 2631, and KS B ISO 5349 on localized vibration is the most widely referred to (KSA, 2015). These describe the measuring method and evaluation of human vibration, and its effects on health and vibration exposure level (Table 3). These industrial standards are also just recommended guidelines without forcibleness.

Table 3. KS B ISO 2631 and 5349

Standard code	Standards
KS B ISO 2631-1	Mechanical vibration and shock-Evaluation of human exposure to whole-body vibration-Part 1: General requirements
KS B ISO 2631-2	Mechanical vibration and shock-Evaluation of human exposure to whole-body vibration-Part 2: Vibration in buildings (1Hz to 80Hz)
KS B ISO 2631-4	Mechanical vibration and shock-Evaluation of human exposure to whole-body vibration-Part 4: Guidelines for the evaluation of the effects of vibration and rotational motion on passenger and crew comfort in fixed-guide way transport systems
KS B ISO 2631-5	Mechanical vibration and shock-Evaluation of human exposure to whole-body vibration-Part 5: Method for evaluation of vibration containing multiple shocks
KS B ISO 5349-1	Mechanical vibration-Measurement and evaluation of human exposure to hand-transmitted vibration-Part 1: General requirements
KS B ISO 5349-2	Mechanical vibration-Measurement and evaluation of human exposure to hand-transmitted vibration-Part 2: Practical guidance for measurement at the workplace

6. Discussion

This paper has investigated the exposure limits of human vibration. As a result, the paper has found that the exposure standards of localized vibration for workers using vibration tools in industrial sites were not regulated by legislation, although, the legislation on the exposure standards of whole-body vibration exists. Concerning the guidelines of the Korea Occupational Safety and Health Agency, only four guidelines on human body exist. The presented exposure limits are limited to only localized vibration, and foreign standards are applied. The KS Standards are just the translation of the guidelines enacted by the ISO. Although, vibration is regarded as a risk factor of musculoskeletal disorders in the recognition standards of diseases on duty, the KS Standards do not present specific safety standards.

Internationally, EU enacted Directive 2002/44/EC (The European Parliament, 2002), and has recommended to institutionalize it as a regulation, standard or guideline to each country. The UK enforces with a separate prevention act, according to the recommendation standards of the EU. The U.S. offers respective threshold limit value (TLV) on localized vibration and whole-body vibration in the American Conference of Governmental Industrial Hygienists (ACGIH) (Kim et al., 2013).

Meanwhile, as a result of applying low frequency vibration of less than 10Hz causing discomfort, targeting 50 Koreans, they reacted more uncomfortably to the vibration of less than 6.3Kz, compared to ISO 2613 (Park, 2006). This is the phenomenon that occurs because Korean people's physical conditions are different from those of Western people, and such a phenomenon implies the need for proper exposure limits to Korean people.

According to a study on the reality of vibration work-engaged workers' exposure to vibration (OSHRI, 2011), daily vibration exposure was the largest in the following order, as a result of survey on major vibration tools: rock drill, chain saw and impact wrench. The exposure to vibration of the investigated grinders and rock drills was more than two times higher than the vibration exposure standard, 5.0m/s^2 , of EU. Among the 20 types of vibration-generating machines and tools at ten investigation-targeted workplaces, 11 products produced in Korea did not indicate vibration acceleration, and only four types among the remaining imports demonstrated vibration acceleration.

The reason why vibration is not properly controlled is that exposure limits to vibration are not set, and vibration is not a subject for working environment measurement. In this regard, workplaces do not have to measure vibration obligatorily, and although such a measurement is made, there is no standard to judge whether exposure limits are exceeded. Therefore, government agencies including the Ministry of Employment & Labor should recognize human vibration as a harmful element against people's safety. In addition, systematic and long-term studies on setting exposure limits suitable for Korean people and working conditions need to be designed by referring to the opinions of academia and industrial sector. In such a process, a single proposal needs to be drawn through cooperation between the Korean Agency for Technology and Standards in charge of KS Standards and the Ministry of Employment & labor taking charge of industrial safety and health laws, regulations and guidelines. Also, an action to obligatorily indicating vibration acceleration on the vibration machines and tools is required.

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References

Kim, D.S., Lee, D.K. and Kim, K.S., Comparative study of the Korean regulations, standards and guidelines for the human vibration with other countries, *Journal of Ergonomic Society of Korea*, 32(4), 321-331, 2013.

Korean Standards Association Website, <http://www.ks.or.kr>, (retrieved January 12, 2015)

Korea Occupational Safety and Health Administration, *Guidance for Measurement and Evaluation of Hand-transmitted Vibration*, KOSHA CODE H-77-2012, 2012.

Korea Workers' Compensation and Welfare Service, *Guideline for Investigation and Judgment of Occupational Diseases* (3rd ed.), 2015.

Mansfield, N.J., *Human Response to Vibration*, CRC Press, Boca Raton, 2005.

Ministry of Employment and Labor, *Industrial Accident Compensation Insurance Act*, 2012.

Ministry of Employment and Labor, *Industrial Safety and Health Act*, 2015.

Ministry of Environment, *Noise and Vibration Control Act*, 2015.

Occupational Safety and Health Research Institute, *Research on the Exposure of Workers in Vibration Works*, 2011.

Park, S.J., Subjective responses of Korean people to vibration, *Sound and Vibration*, 16(4), 68-74, 2006.

The European Parliament and the Council of the European union, Directive 2002/44/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration), *Official Journal of the European Communities*, 2002.

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Areas of interest: Work-related musculoskeletal disorders, human vibration, work analysis and design