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NEW COMPREHENSIVE QUESTIONNAIRE FOR ERGONOMIC RISK FACTORS IDENTIFICATION TO HEALTH AND SAFETY AT WORK – ERIQ^{AZ}

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Abstract Ergonomic risk factors are paramount in the preservation of worker health and safety, but identification in practice has generally been limited to a small number of mainly biomechanical risk factors. The primary purpose of this paper is to introduce ERIQ^{AZ} (Ergonomic Risks Identification Questionnaire), a holistic tool for the identification of ergonomic risks in the workplace. The research aims to support addressing ergonomic risk assessment limitations that presently self-identify as biomechanical and physical risks (for example, awkward postures and vibrations), but do not seek to include a comprehensive range of ergonomic risks. The emphasis in ERIQ^{AZ} is on 12 key areas of risk - ergonomic factors with physical, psychological, physiological, anthropometric, biomechanical, sociological, organizational, design-based, technological, personal, and biological components, including ergonomic risk factors based on the discomfort component. The questionnaire is intended to facilitate precise and holistic identification of relevant ergonomic hazards present in some work environments, especially in systems with high interaction between workers and work objects, tools, machines, equipment, and environments. Each of the 58 items in this questionnaire is measured using a five-level Likert scale to rate how often the worker is exposed to risk, and each risk item has defined effects on health and safety. Validation was carried out through expert evaluation (content validity) and interviews with workers (face validity), while the questions and the questionnaire met the criteria (I-CVI $\geq$ 0.8, S-CVI/Ave = 1). ERIQ^{AZ} has allowed for a holistic identification of ergonomic risk factors. It is practical for application in complex industrial systems, and will be a basis for preventive and corrective action. In addition, ERIQ^{AZ} enables workers to initiate assessment of ergonomic risks themselves, using the Likert scale that helps them take part in health and safety risk assessment, as required by ISO 45001:2018. Using this tool can assist in preventing occupational diseases, injuries and accidents in the system. It will also alert that ergonomic hazards affect people. The tool is expected to be of primary benefit to ergonomic professionals, researchers, and safety managers.

Keywords: Ergonomic risk factors; ergonomic hazards; risk assessment; health; safety; ERIQ^{AZ}.

1. INTRODUCTION

Ergonomic risk factors are fundamental health and safety determinants for workers so their identification and evaluation become vital for injury and occupational disease prevention. The concepts of risk and hazard are very closely related. In the most concise form, risk can be defined as a quantified hazard. Therefore, in a qualitative sense, there is no difference between hazard and risk as they refer to the same event (a certain possibility), but in a quantitative sense, there is a distinction. For this reason, in this paper, a strict terminological difference between risk and hazard will not be made in a qualitative sense when describing an event (interaction) that may lead to health and safety issues.

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Most authors also make no distinction from the previously mentioned perspective, implicitly accepting this fact. The concept of ergonomic risk factors has developed in parallel within other scientific disciplines. However, most of the ergonomic research has been directed at biomechanical factors, which are usually considered the only formally recognized ergonomic risk factor. This viewpoint causes a narrow view of ergonomics and its importance, consequently lowering the possibility of realizing a holistic risk assessment and efficient prevention of occupational injuries.

Previously published studies in the field of ergonomics mainly deal with biomechanical risk factors, for example, awkward working postures, repetitive movements, prolonged static positions and similar, directly connected to the occurrence of musculoskeletal disorders. An approach limited to only one or eventually two of many ergonomic risk factors may, however, be inadequate to provide a sufficiently accurate understanding of the causes of occupational diseases and injuries because it does not take into account other important ergonomic risk factors that can affect the health and safety of workers and work systems.

In addition to biomechanical factors, only a few physical risk factors are traditionally considered in the context of ergonomic risk research. Factors such as vibrations and temperature are sometimes included in complex ergonomic risk analyses in the workplace, but there is a noticeable absence of other ergonomic risk factors with a physical component that have a real impact on employees' working ability and health. Furthermore, ergonomic risk factors with psychological, physiological, anthropometric, sociological, organizational, design, technological, personal, and biological components, as well as risk factors that take into account the absence of comfort, are often overlooked or not treated at all as part of ergonomic risk factors in research.

Many examples illustrate this situation. For instance, in the study [1], the following factors were considered as ergonomic risk factors:

- force exertion
- demanding posture
- repetitive movement
- hand-arm vibration
- lifting
- kneeling or squatting
- climbing.

In the study [2], the authors explicitly focus on musculoskeletal disorders as the main ergonomic risk. Body postures, repetitive movements, and interaction with patients (in terms of the loads being handled) are described as causes or as conditions under which these disorders arise, although they are not explicitly named as risk factors. In the study [3], the authors explicitly identify the following factors as ergonomic risk factors:

- awkward posture
- force
- repetitive movement
- vibration

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- static loading
- contact stress
- extreme temperature.

From these and other examples, it can be observed that analyses of ergonomic risk factors cover a relatively small number of factors, which is not sufficient for a comprehensive assessment of ergonomic risk factors in an industrial environment. On the other hand, unlike the previously mentioned ergonomic assessments, workplace risk assessments in the domain of health and safety often include various areas of risk but not all relevant areas of workplace risks. These risks can primarily be classified under the domain of physical risk factors. However, such analyses also do not cover all risk factors that may be present in the work environment, leading to the need for a comprehensive identification of ergonomic risk factors that impact the health and safety of workers and systems. Such a kind of assessment requires the design of a new tool that will enable this process. With that in mind, the topic of this paper is the design of a comprehensive questionnaire for ergonomic risk identification in the work environment.

2. PROBLEM AND AIM OF THE RESEARCH

The problem arises from the fact that previously published scientific papers addressing ergonomic risk factors mostly include a limited number of these factors, thereby neglecting the complex and multidimensional nature of ergonomics, as well as its past and potential practical contributions to identifying risk factors. Specifically, the literature identifies certain ergonomic risk factors, primarily in the domain of biomechanical factors and a few from the category of physical risk factors, as outlined in the introductory chapter. Other ergonomic risk factors, such as those with psychological, physiological, anthropometric, sociological, organizational, design, technological, personal, discomfort-related, and biological components, have not been previously considered. An exception is the study [4], which presented 12 main areas of ergonomic risk factors, with formulated sub-areas of ergonomic risk factors. If the assessment of ergonomic risk factors does not take into account all 12 main areas, such limitations reduce the possibility of a realistic and comprehensive risk assessment in the workplace, especially in complex work systems where the interaction of humans with work objects, tools, and equipment can lead to various health problems and disorders, as well as decreased workplace safety.

The aim of this paper is the creation of a complex and comprehensive questionnaire that will encompass all 12 main areas of ergonomic risk factors listed in study [4], i.e., risk factors with physical, psychological, physiological, anthropometric, sociological, organizational, design, technological, personal, and biological components, as well as risk factors that take into account the discomfort component. Such a questionnaire will enable a comprehensive assessment of ergonomic risks in the work environment, providing precise identification of all ergonomic risk factors relevant to the health and safety of workers, especially in complex work systems where significant interaction exists between humans and work objects, tools, and equipment.

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3. QUESTIONNAIRE DEVELOPMENT

The comprehensive questionnaire for assessing ergonomic risk factors will be developed based on precisely identified ergonomic risk factors from Zunjic's study, published in the journal IETI TES [4]. The main reason for this is that the study defines over 55 different ergonomic risk factors, which is a qualitatively and quantitatively significantly greater number of risk factors compared to any previously published scientific article.

The sections of the questionnaire should directly correspond to the areas defined in the mentioned study, where, as stated, a total of 12 key areas of ergonomic risk factors were identified: with physical, psychological, physiological, anthropometric, sociological, organizational, design, technological, personal, biological components, as well as the area of risk factors that take the discomfort component into account. For each individual subchapter within the stated areas from study [4], one specific question for assessing ergonomic risk will be formulated. Each question will be constructed to clearly encompass:

- A description of the worker's interaction with the work object, equipment, or work environment
- Outlined effects of that interaction on the worker's health
- Specifically defined effects on work safety.

The questionnaire should contain only the minimum necessary number of questions. An excessive number of questions could discourage workers from starting or completing the questionnaire (each question representing a sub-area of risk factors could, of course, be further differentiated, which would further increase the scope of the questionnaire). The impact on the questionnaire's scope is another reason why questions related to health and safety will not be separated (doing so would double the number of questions in the questionnaire).

Additionally, each question must be structured in accordance with readability principles (clarity, precision, and unambiguity), and the chosen style should allow workers to clearly identify the presence of a specific risk. The interaction described in each question should be precise to accurately determine the nature of the hazard, while the effects on health and workplace safety within each question should be distinctly outlined. This helps respondents associate the effects with their work experience, thereby additionally raising awareness among workers about the importance of studying ergonomic risk factors and their impact on health and safety.

As mentioned, for each individual subchapter identified in study [4], one corresponding question in the questionnaire will be formulated, ensuring systematicity, comprehensiveness, and detail in the assessment of ergonomic risk. A questionnaire with these characteristics aims to provide a realistic and complete identification of ergonomic risks. This tool is especially applicable in complex work systems, where intense interactions of employees with work objects, tools, equipment, and the environment may lead to a wide range of health and safety issues.

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4. CONTENT OF THE QUESTIONNAIRE

This questionnaire identifies ergonomic risk factors that impact health and safety. As mentioned, health and safety are conceptually viewed here as a connected entity, based on the understanding that an unhealthy environment cannot be safe, and vice versa. This concept is widely accepted and applied by many scientifically significant institutions, such as the International Ergonomics Association (IEA), the Occupational Safety and Health Administration (OSHA), and others. Annex 1 presents the final version of the questionnaire for ergonomic risk identification, with questions categorized by the main areas of ergonomic risk. Additionally, Annex 2 provides a glossary of terms that may be potentially unfamiliar to some workers.

5. THE WAY OF USING THE QUESTIONNAIRE

The developed questionnaire for identifying ergonomic risk factors consists of questions based on the Likert scale. Workers are tasked with circling one of the numbers provided following each question (1-5). The Likert scale used in the questionnaire has five rating levels, with the following meanings:

1 – Never

2 – Rarely

3 – Occasionally

4 – Often

5 – Very often or constantly.

Methodologically speaking, the procedure for applying the questionnaire includes the following steps:

- Clearly defining the target group of respondents, i.e., employees who have intensive interaction with work objects, tools, or work equipment in various work systems

- Explaining to the respondents the purpose of the questionnaire and the need for honest and accurate responses to realistically assess ergonomic risks

- Individual completion of the questionnaire by the employees, with the possibility of additional clarification from the researcher (ergonomics expert)

- Analysis of the results based on the collected data, identifying the most critical risk factors in individual areas of ergonomic risks.

Following these steps, depending on the client’s requirements, the ergonomics expert can then formulate recommendations and to propose measures to reduce or eliminate the identified ergonomic risks.

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6. VALIDITY OF THE QUESTIONNAIRE

The validity of the questionnaire was ensured through multiple procedures. Firstly, the content validity of the questionnaire was achieved by basing it on the relevant literature [4], which provided a detailed analysis and identification of all relevant ergonomic risk factors. The content validity of the questionnaire was confirmed through the method of expert evaluation. Two experts in the field of ergonomics reviewed the questions, assessing their clarity, relevance, and completeness in covering the identified ergonomic risk factors. According to Davis [5], when content validity is assessed by two experts, the I-CVI (item-level content validity index) value should be $\geqslant 0.8$. Every question in the questionnaire met this criterion. Furthermore, the S-CVI (scale-level content validity index) was also determined. The S-CVI/Ave (based on I-CVI) value amounted to 1.

Face validity was assessed using a qualitative approach, in accordance with [6], through the application of interviews. The sample included workers from various industrial sectors, considering that the questionnaire addresses a broad spectrum of ergonomic risk factors. A total of 11 respondents participated in individual interviews. Respondents were given the questionnaire and then asked to comment on the items in terms of their clarity, comprehensibility, and relevance. The following open-ended questions were asked:

Do you understand all the questions presented to you?

Do you feel the questions relate to your work experience?

Are there any terms you don't understand or would phrase differently?

Do you find any questions in the survey to be unimportant or unrelated to your current workplace?

The respondents discussed the questions and shared their opinions on their relevance and accuracy. During the discussion, suggestions for improving the questionnaire were recorded. Thematic analysis of gathered comments revealed fundamental themes about question clarity as well as relevance and possible ambiguous aspects. Qualitative feedback analysis has shown that most respondents understood survey questions well, while some participants did not recognize a few terms, such as the "vibration syndrome" and "cognitive effort". As a result of these observations, it was decided to create a glossary of terms as an appendix to the questionnaire to clarify potentially unclear terms for some respondents. This procedure protects the question format and shortness while maintaining a clear understanding.

All participants recognized the questions as relevant to their work environment. However, not all questions are equally tailored or necessary for all sectors, such as the administrative sector. Nevertheless, even in such cases, the questionnaire remains valid, as workers have the option to respond to such questions with a 1 on the 1-to-5 scale, indicating that they have never been exposed to such an interaction or such a risk factor.

A minority of responders found some questions lengthy and complex yet maintained they were still clearly worded and precise. For this reason, only minimal adjustments were made to a small number of questions to reduce their length without compromising their precision or clarity.

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None of the respondents indicated that the questions were offensive, overly personal, or inappropriate. The results of the qualitative analysis showed that the questionnaire generally possesses a high level of face validity.

7. CONCLUSION

Ergonomic risk factors represent specific forms of worker interaction with elements of the work system (physical, psychological, organizational, technological, design-related, social, and others), which may cause adverse effects on workers' health and/or work safety. Previous ergonomic analyses related to the identification of ergonomic risks have encompassed qualitatively relatively small number of hazards, which has been insufficient for a comprehensive risk assessment in industrial environments. A similar situation exists in the literature focusing on the identification of ergonomic hazards. For instance, in studies [7-9], ergonomic hazards are primarily viewed as those leading to musculoskeletal disorders.

One reason for the limited number of identified ergonomic risk factors in the mentioned literature lies in the inadequate understanding of ergonomics. For example, [8] states that "ergonomic hazards refer to the physical conditions in the workplace that pose musculoskeletal injuries and disorders over time." This relatively narrow interpretation of ergonomics has led to the general perception that ergonomic risks are predominantly associated with musculoskeletal disorders. However, the contribution of ergonomics to the identification of risk factors is undoubtedly much broader, as demonstrated in study [4], which served as the foundation for developing the new questionnaire for identifying ergonomic risks presented in this paper.

To address the described limitation, a new questionnaire named ERIQ^{AZ} (Ergonomic Risks Identification Questionnaire) was developed. To distinguish the name of this questionnaire from another ERIQ questionnaire (Effort-Reward Imbalance Questionnaire), which is unrelated to the issues discussed in this paper, the initials of the authors were added in superscript (AZ). In terms of structure, ERIQ^{AZ} encompasses 12 areas of ergonomic risk factors and includes a total of 58 questions. Each question represents a sub-area of ergonomic risk factors in relation to the main areas of risk factors (of which there are 12). This data indicates that ERIQ^{AZ} covers more areas and sub-areas than any other previously developed tool for identifying and assessing ergonomic risks in the workplace.

Regarding the number of areas identified in the questionnaire (12), one of the goals in designing the questionnaire was to establish a balance between the number of areas and sub-areas. Given the interdependence between certain ergonomic risk areas, one possibility was to classify ergonomic risk factors with a personal component as a sub-area within ergonomic risk factors with a sociological component. Similarly, ergonomic risk factors with a design component and ergonomic risk factors with a technological component could have been sub-areas within ergonomic risk factors with a physical component. In this way, ergonomic risk factors with a biological component could also be part of ergonomic risk factors with a physiological component, while ergonomic risk factors that take discomfort into account could be a sub-area within ergonomic risk factors with a biomechanical component. In this way, the number of main areas of ergonomic risk factors would be reduced from 12 to 7. Even in that case, this questionnaire would cover more risk factors areas than any other questionnaire in the field of ergonomics or occupational health and safety. However, this reduction in

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the number of ergonomic risk factor areas was abandoned because the five mentioned areas are sufficiently differentiated and important enough to be considered separate areas when identifying risk factors. Their thematic specificity significantly facilitates result analysis during risk assessment.

In previous research, certain ergonomic risk factors were sometimes referred to by different names, although they essentially referred to the same risk. However, regardless of their names, the factors mentioned in the literature [1-3] are also present in some form in this new questionnaire. When designing the questions for the ERIQ^{AZ} questionnaire, attention was given to ensuring that the questions do not repeat, as some areas and sub-areas of ergonomic risk factors are mutually correlated.

Although this questionnaire may initially seem extensive due to containing more questions than most other questionnaires of its kind, in essence, ERIQ^{AZ} includes only the necessary number of essential questions for risk identification. Some questionnaires in other fields contain over 500 questions (e.g., the Minnesota Multiphasic Personality Inventory). Regarding the length of the questions, they may appear long at first glance. However, each question includes descriptions of health and safety effects that help workers associate them with specific risk factors. Additionally, the intention was not to list all possible health and safety effects that a given risk factor might cause, but only the fundamental ones to facilitate understanding of the questions. If the health and safety effects were omitted from the questionnaire, the questions would be about 50% shorter. However, this approach was abandoned because this question format further connects ergonomic risk factors with their health and safety effects, clearly presenting the questionnaire's purpose.

Additionally, questionnaires with lengthy questions are not uncommon. For example, the Job Content Questionnaire (JCQ) contains individual questions that can be as long as over half a page. It should be noted that ERIQ^{AZ} could potentially include a significantly larger number of questions, given that a question within a specific sub-area of the questionnaire could be differentiated to identify certain specific risks or their causes. In this way, the number of questions in the questionnaire could approximately increase five to ten times.

Most definitions of ergonomics, such as the one presented in [10] (and many others), include the notion of interaction, as the focus of ergonomics as a science is on the interaction of humans with any entity—machine, work object, product, environment, other people, or any other object during the execution of work processes. With this in mind, the questionnaire is designed so that ergonomic risk factors are identified through various forms of interactions. This means that the ergonomic nature of the questionnaire is ensured by formulating questions that describe specific types of interactions posing risks to workers' health and safety. Thus, the questions are structured so that a specific risk factor is identified as a result of human interaction with an entity (or phenomenon) described in the question, with the stated health and safety effects merely being the consequence of that interaction.

The questionnaire is designed for workers to complete independently. This methodological approach aligns with the ISO 45001:2018 standard [11], which emphasizes worker involvement in the identification and assessment of risks. Since the ISO 45001:2018 standard does not provide a specific tool for workers to use in ergonomic risk assessments, the ERIQ^{AZ} questionnaire can be recommended as a supplement to this standard. It provides workers with a tool to identify ergonomic hazards and risks. It is worth mentioning that some international institutions in the field of

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occupational safety and health encourage workers to use their online questionnaires for risk assessment. However, the ERIQ^{AZ} questionnaire covers more risk areas even compared to these international tools, as it considers risk as a result of interaction, treating health and safety risks from an ergonomic perspective.

To reduce the questionnaire's length, the questions are designed to avoid separating effects on health and safety. Otherwise, the size of the questionnaire would at least double, which could negatively impact workers' motivation to complete it. Since ergonomics is a science that studies the interaction of humans with any object or environment, the ergonomic character of the questionnaire is ensured by having each question describe a specific type of interaction that potentially poses a risk. Additionally, as previously mentioned, the questions are formulated to examine the impact of those interactions on both health and safety.

The questionnaire demonstrated a satisfactory level of structural and face validity. Its application in real-world settings will enable the testing of additional forms of validity.

The administration of the questionnaire in the field and the analysis of the collected data should be carried out by ergonomics experts. During testing, these experts should provide support to ensure that any questions or concerns raised by workers regarding the questionnaire are properly clarified. The questionnaire enables qualitative analysis, i.e., the identification of ergonomic hazards (risks). However, since the questionnaire is designed using a five-point Likert scale, it also allows for the determination of the frequency of exposure to each ergonomic risk. In this way, beyond identifying individual ergonomic risks, the questionnaire also enables the identification of those risks most frequently present in the work environment. This, in turn, supports the development of a precise prioritization plan for interventions. The design and implementation of ergonomic risk intervention and prevention plans should be overseen by experts in the field of ergonomics.

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APPENDIX 1

ERIQ^{AZ} - ERGONOMIC RISK IDENTIFICATION QUESTIONNAIRE

Instructions for Completing the Questionnaire

Dear Participants,

This questionnaire is designed to identify ergonomic risk factors in your work environment that have effects on your health and safety. Please read the instructions carefully before proceeding with completion.

How to Complete the Questionnaire

Each question in the questionnaire pertains to a specific aspect of your work, working environment and ergonomic working conditions. Circle a number from 1 to 5 to indicate the frequency of occurrence for each described risk factor:
1 – Never 2 – Rarely 3 – Occasionally 4 – Often 5 – Very often or constantly

Important Notes

Your honest and accurate answers will create reliable results that accurately measure ergonomic risks. The questionnaire is to be completed individually, without consulting colleagues. If you have any uncertainties, you may contact the tester (ergonomics expert) for further clarification. There are no right or wrong answers, it is only important to respond precisely based on your personal experience.

Purpose of the Questionnaire

The data collected through this questionnaire will serve to identify and analyze ergonomic risk factors in various work systems. The gathered responses will enable professionals to create recommendations that both enhance workplace settings and minimize ergonomic risks.

Thank you in advance for your time and contribution to this research!

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QUESTIONS

1. Ergonomic risk factors with a physical component

1. Do high levels of noise generated during your interaction with workplace objects or from the work environment negatively affect your health through hearing damage, stress, or issues with the cardiovascular and digestive systems, and/or workplace safety through an increased number of errors, impaired communication, reduced ability to perceive auditory warnings, or slowed reactions?

   1 2 3 4 5

2. Does exposure to vibrations generated during your interaction with machines and tools negatively affect your health through nerve and blood vessel damage or the development of vibration syndrome, and/or workplace safety through reduced hand sensitivity, loss of control over tools, and an increased risk of accidents?

   1 2 3 4 5

3. Do unfavorable or extreme temperatures during your interaction with the work environment or work object negatively affect your health through dehydration, muscle cramps, dizziness, shivering, hypothermia, or frostbite, and/or workplace safety through reduced concentration, increased number of errors, or higher risk of accidents?

   1 2 3 4 5

4. Does inadequate lighting during your interaction with the work environment or work object negatively affect your health through eye strain, headaches, and vision problems, and/or workplace safety through an increased risk of making errors, tripping, falling, or difficulty detecting hazards?

   1 2 3 4 5

5. Does exposure to harmful particles or chemicals generated during your interaction with the work object or work environment negatively affect your health through respiratory problems, occupational diseases, and allergies, and/or workplace safety through reduced visibility, distraction, and increased risk of accidents?

   1 2 3 4 5

6. Does inadequate air humidity during your interaction with the work environment negatively affect your health through impaired heat dissipation and an increased risk of heat stress, and/or workplace safety through difficulty performing tasks and an increased risk of errors?

   1 2 3 4 5

7. Do slippery and uneven surfaces during your interaction with them at the workplace negatively affect your health through injuries or permanent pain in the legs or arms, and/or workplace safety through loss of control over equipment or vehicles?

   1 2 3 4 5

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8. Does interaction with sharp or hot surfaces at the workplace affect your health through cuts, burns, infections, and scars, and/or workplace safety through unintended movements, dropping objects or tools, and an increased risk of accidents?

   1 2 3 4 5

9. Does your interaction with accelerating objects negatively affect your health through musculoskeletal injuries, internal organ damage, fatigue, and stress, and/or workplace safety through an increased risk of falls and accidents, or loss of control over tools, machines, or vehicles?

   1 2 3 4 5

10. Does exposure to extreme or variable pressures during your interaction with workplace equipment or from the work environment negatively affect your health through barotrauma, decompression sickness, hypoxia, fatigue, cardiovascular issues, or reduction in cognitive and motor functions, and/or workplace safety through an increased risk of explosions, implosions, or equipment failures?

    1 2 3 4 5

11. Does exposure to fire during your interaction with work objects or parts of the workplace negatively affect your health through burns, respiratory issues, stress, or post-traumatic stress disorder, and/or workplace safety through equipment and infrastructure damage, an increased risk of explosions, or the release of hazardous substances?

    1 2 3 4 5

12. Does your interaction with electrical installations and equipment at the workplace negatively affect your health through electric shocks, burns, or internal organ damage, and/or workplace safety through an increased risk of fire, explosions, equipment failures, or system errors?

    1 2 3 4 5

13. Does exposure to electromagnetic fields at the workplace during your interaction with equipment that generates them or the work environment negatively affect your health through headaches, fatigue, stress, nervous system damage, or an increased risk of cardiovascular and other serious diseases, and/or workplace safety through equipment malfunctions, interference with electronic devices, or an increased risk of accidents due to technical issues or attention problems?

    1 2 3 4 5

14. Does exposure to UV, IR, laser, or microwave radiation during your interaction with equipment that generates them or the work environment negatively affect your health through burns, eye damage, skin diseases, cataracts, or other long-term health issues, and/or workplace safety through reduced visibility, technical malfunctions, or distraction that may increase the risk of accidents?

    1 2 3 4 5

15. Is there a possibility of your interaction with moving parts of a machine that could pose a risk to your health through injuries such as cuts, fractures, or amputations, and/or to workplace safety due to unexpected movements, lack of protective barriers, or inadequate training?

    1 2 3 4 5

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16. Is there a possibility of an explosion as a result of your interaction with the work object, equipment, or environment that could impact your health through burns, internal injuries, hearing damage, or post-traumatic stress disorder, and/or workplace safety through secondary incidents such as fires, toxic gas releases, or infrastructure collapse?

    1 2 3 4 5

17. Does your work at heights or unsafe interaction with climbing points negatively affect your health through fractures, sprains, head and spine injuries, or lead to long-term health consequences due to falls, and/or workplace safety through the interruption of work activities as a result of a fall?

    1 2 3 4 5

18. Can the movement of vehicles and machinery result in unintended interaction with you or with objects in the workplace, which could negatively impact your health through fractures, sprains, spinal or internal organ injuries, and/or workplace safety by increasing the risk of property damage or jeopardizing the continuity of work activities?

    1 2 3 4 5

2. Ergonomic risk factors with a psychological component

19. Does your interaction with work tasks result in information overload that negatively affects your health through mental fatigue, stress, anxiety, depression, or sleep disorders, and/or workplace safety through an increased risk of errors, accidents, or injuries in the workplace?

    1 2 3 4 5

20. Does your interaction based on the resolution of complex cognitive tasks negatively affect your health through mental exhaustion, stress, anxiety, or tension headaches, and/or workplace safety through an increased risk of mental lapses, misjudgments, delayed reactions, or reduced ability to recognize hazards in the work environment?

    1 2 3 4 5

21. Does your interaction with the work object or work environment result in sensory overload that negatively affects your health through headaches, dizziness, nausea, or elevated blood pressure, and/or workplace safety through an increased risk of distraction, missing important information, or inadequate reactions that may lead to errors and accidents?

    1 2 3 4 5

22. Does your interaction with monotonous work tasks lead to work monotony, resulting in increased health risks such as depression, anxiety, circulation problems, back and neck pain, or the development of cardiovascular diseases, and/or safety risks through reduced attention, slower reactions, and a higher likelihood of errors and accidents?

    1 2 3 4 5

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3. Ergonomic risk factors with a physiological component

23. Does your interaction with objects during the execution of work tasks involve high physical exertion that negatively affects your health through muscle and joint injuries or long-term physiological changes due to prolonged strain without adequate rest, and/or workplace safety through reduced attention, an increased risk of errors, and a higher likelihood of accidents?

    1 2 3 4 5

24. Does your interaction with the work object result in awkward working postures that manifest as health problems such as back, neck, shoulder, joint, or spinal pain, as well as the development of chronic degenerative conditions, and/or affect workplace safety through reduced attention, impaired motor skills, and an increased risk of accidents?

    1 2 3 4 5

4. Ergonomic risk factors with an anthropometric component

25. Does your interaction with a chair, due to its inadequate size or shape, negatively affect your health through poor posture, reduced circulation, increased pressure on certain parts of the body causing pain and long-term health problems, and/or workplace safety through reduced attention, frequent interruptions of work activities, or an increased risk of errors and accidents?

    1 2 3 4 5

26. Does your interaction with tool handles or inadequately designed grips on devices negatively affect your health through increased fatigue caused by excessive force, improper movements, hand strain, the development of carpal tunnel syndrome, and other cumulative injuries, and/or workplace safety through reduced work precision, impaired tool control, and a higher risk of accidents due to tool slippage or dropping?

    1 2 3 4 5

27. Does your interaction with elements of the work task in a limited space for movement negatively affect your health through forced adoption of unnatural body postures, pain, and musculoskeletal problems, and/or workplace safety through an increased risk of tripping, falling, and impaired response in emergency situations?

    1 2 3 4 5

28. Does your interaction with a display screen that is not properly positioned in terms of height or distance negatively affect your health through eye strain, neck and shoulder pain, headaches, and long-term vision problems, and/or workplace safety through a reduced field of vision, slower reactions, and an increased risk of errors and accidents within the system?

    1 2 3 4 5

29. Does your interaction with protective equipment of inadequate size and design negatively affect your health through reduced protection efficiency, discomfort, pressure on certain body parts, circulation problems, nerve compression syndromes, or chronic inflammation, and/or workplace safety through reduced mobility, slower reactions, and an increased risk of accidents?

    1 2 3 4 5

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30. Does your interaction with the workplace components involving a mismatch between their dimensions and your anthropometric characteristics negatively affect your health through improper body postures, muscle strain, pain, and musculoskeletal disorders, and/or workplace safety through reduced precision, increased risk of errors, and accidents within the system?

    1 2 3 4 5

5. Ergonomic risk factors with a biomechanical component

31. Does your interaction with machines, tools, or work objects involving repetitive movements negatively affect your health through the development of cumulative trauma disorders such as tendinitis, carpal tunnel syndrome, or tennis elbow, as well as pain, inflammation, and reduced mobility of the limbs, and/or workplace safety through reduced precision and a higher risk of errors or injuries due to fatigue, decreased concentration, and loss of control over tools or equipment?

    1 2 3 4 5

32. Does your interaction with the work object, involving long-term performance of movements in inadequate body positions, negatively affect your health through muscle and joint strain, back, neck or knee pain, as well as the development of musculoskeletal disorders, and/or workplace safety through the occurrence of an increased number of errors or the possibility of equipment damage?

    1 2 3 4 5

33. Does your interaction with the load, based on manual material handling, negatively affect your health through sprains, strains, back injuries, pains in the spine, shoulders or joints, as well as the development of chronic musculoskeletal disorders such as carpal tunnel syndrome or disc disease, and/or workplace safety through an increased risk of dropping the load and its damage due to stumbling, falls or limited visibility?

    1 2 3 4 5

34. Is your interaction with the elements of the work task characterized by the use of excessive force, negatively affecting your health through injuries to muscles, tendons, and ligaments, inflammation, and degenerative changes in the joints, and/or workplace safety through loss of control over tools or the load?

    1 2 3 4 5

35. Does your interaction with work objects or equipment involve remaining in the same body position for an extended period (e.g., standing, sitting, or holding an object without changing posture), which affects your health through excessive fatigue, pain, or damage to muscles and joints, and/or workplace safety through reduced attention and responsiveness in hazardous situations?

    1 2 3 4 5

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6. Ergonomic risk factors with a sociological component

36. Is your interaction with colleagues characterized by inadequate communication that negatively affects your health through stress, confusion, a sense of isolation, demotivation, or an increased risk of depression, and/or workplace safety through difficulty in recognizing critical safety information and inadequate response in emergency situations?

    1 2 3 4 5

37. Does there exist interference between your interactions at work (with the work object, machines, equipment, colleagues) and your life interactions (family, social), which negatively affects your health through stress and burnout syndrome, and/or workplace safety through reduced attention and increased risk of errors in the system?

    1 2 3 4 5

38. Are your interactions with work tasks and the environment disrupted by professional stagnation and a lack of adequate rewards, which negatively impacts your health through dissatisfaction, chronic stress, and weakened immunity, and/or workplace safety through reduced productivity, lower levels of attention, increased risk of errors when handling tools and machinery, as well as decreased proactivity in recognizing potential risks?

    1 2 3 4 5

39. Does your interaction with colleagues or groups in the work environment involve violence or abuse, which negatively affect your health through stress, anxiety, depression, sleep disorders, post-traumatic stress disorder, headaches, or weakened immunity, and/or workplace safety through an increased risk of physical conflicts, equipment sabotage, or a higher number of work errors that can jeopardize the functioning of the system?

    1 2 3 4 5

7. Ergonomic risk factors with an organizational component

40. Is your interaction with work tasks characterized by excessive workload resulting from inadequate work organization, which negatively affects your health through chronic stress, anxiety, fatigue, exhaustion, burnout syndrome, and depression, and/or workplace safety through an increased likelihood of errors and a higher risk of accidents?

    1 2 3 4 5

41. Is your interaction with work tasks characterized by inadequate breaks and insufficient rest periods, which negatively affect your health through physical and mental exhaustion, chronic fatigue, stress, and reduced work capacity, and/or workplace safety through an increased risk of errors, slower reactions to unexpected situations, and a higher likelihood of injuries in hazardous conditions?

    1 2 3 4 5

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42. Is your interaction with components of the work task negatively affected by incomplete or inadequate training, impacting your health through stress or anxiety due to uncertainty in task performance, and/or workplace safety through the development of unsafe work practices, an increased risk of errors, and a higher likelihood of workplace injuries?

    1 2 3 4 5

8. Ergonomic risk factors with a design component

43. Does your interaction with equipment using inadequately designed control devices (command interfaces) negatively affect your health through cognitive overload and stress, and/or workplace safety through an increased risk of errors, activation of incorrect controls, and a higher likelihood of accidents, especially in high-stress situations?

    1 2 3 4 5

44. Does your interaction with displayed information on a poorly designed or improperly adjusted screen negatively affect your health through visual fatigue and vision impairment, and/or workplace safety through difficulty in recognizing information, work omissions, and an increased risk of errors in the controlled system?

    1 2 3 4 5

45. Does your interaction with the machine, work object, and work environment involve deficiencies in the design of guards and protective devices that may negatively affect your health through inadequate protection from harmful factors and an increased risk of occupational diseases, and/or workplace safety through unsafe barriers that may lead to unintended contact with objects and a higher risk of injuries?

    1 2 3 4 5

46. Does your interaction with non-ergonomically designed work clothing and footwear negatively affect your health through contact with harmful materials that may cause health problems, and/or workplace safety through an increased risk of tripping, falling, and unintended movements that may lead to injuries?

    1 2 3 4 5

9. Ergonomic risk factors with a technological component

47. Does your interaction with the work object in an inadequately automated process negatively affect your health through an increased risk of musculoskeletal disorders, frustration, and stress due to an unpredictable or poorly adjusted work pace, and/or workplace safety through temporary or permanent loss of process control, especially during transitions between manual and automated operation?

    1 2 3 4 5

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48. Does your interaction with technology whose functioning or features do not meet your expectations negatively affect your health through frustration, stress, increased cognitive load, mental and physical exhaustion, blurred vision, dry eyes, headaches, or muscle tension in the neck and back, and/or workplace safety through an increased risk of errors, injuries, or insufficient protection due to the unpredictable behavior of the technology?

    1 2 3 4 5

49. Does your interaction with equipment involve inadequate, unclear, or incomplete instructions for using the technology, which may negatively affect you through an increased risk of improper use that could endanger your health, and/or workplace safety through unsafe conditions and a higher likelihood of injuries and operational errors?

    1 2 3 4 5

10. Ergonomic risk factors with a personal component

50. Is your interaction with the work object characterized by a mismatch between task requirements and your experience and skills, which negatively affects your health through frustration, loss of confidence, stress, and anxiety, and/or workplace safety through an increased risk of errors that may compromise system performance?

    1 2 3 4 5

51. Does your interaction with the work task occur at a time misaligned with your circadian rhythm, negatively affecting your health through sleep disturbances, metabolic and hormonal imbalances, and/or workplace safety through reduced alertness, slower reactions in emergency situations, and an increased risk of accidents?

    1 2 3 4 5

52. Is your interaction with the work object characterized by a mismatch between your age and the task demands, which negatively affects your health through faster physical and mental fatigue, chronic exhaustion, and an increased risk of age-related chronic illnesses, and/or workplace safety through reduced task performance effectiveness and a higher risk of accidents?

    1 2 3 4 5

53. Is your interaction with the work object characterized by a mismatch between task demands and your abilities due to a disability or specific limitations, negatively affecting your health through an increased risk of health problems, and/or workplace safety through reduced adaptability, a higher likelihood of errors, and an increased risk to personal and property safety?

    1 2 3 4 5

11. Ergonomic risk factors with a discomfort component

54. Is your interaction with work tasks characterized by a lack of a comfortable space for rest and relaxation during breaks, which negatively affects your health through reduced physical activity, chronic fatigue, weakened cognition, sleep disorders, impaired psychomotor coordination, weakened immunity and increased risk of chronic diseases, and/or work safety through increased probability of errors, reduced alertness and slower reactions in critical situations?

    1 2 3 4 5

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55. Is your interaction with the work environment or work tasks characterized by a prolonged discomfort of any kind, which negatively affects your health through chronic stress, cardiovascular problems, gastrointestinal issues, pain and musculoskeletal disorders, weakened immunity or psychological disorders, and/or work safety through decreased attention and increased risk of accidents?

    1 2 3 4 5

12. Ergonomic risk factors with a biological component

56. Is your interaction with the work environment characterized by exposure to pathogenic microorganisms, which negatively affects your health through respiratory diseases, skin conditions, or systemic infections that may cause long-term health problems and reduce work capacity, and/or workplace safety through an increased risk of contamination, infection outbreaks, absenteeism, and compromised safety of materials and the broader environment?

    1 2 3 4 5

57. Is your interaction with the work environment characterized by exposure to allergenic agents, which negatively affects your health through allergic reactions, respiratory issues such as asthma, skin conditions such as dermatitis, or chronic health problems, and/or workplace safety through an increased risk of distraction and a higher likelihood of accidents?

    1 2 3 4 5

58. Is your interaction with the work environment characterized by exposure to biologically hazardous materials, which negatively affects your health through an increased risk of contamination and related health problems, and/or workplace safety through the endangerment of the safety of all employees or the broader community?

    1 2 3 4 5

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APPENDIX 2

INDEX

1. *Vibration Syndrome* - a health disorder caused by prolonged exposure to vibrations that results in tingling sensations, numbness, and loss of sensation in the hands.
2. *Hypothermia* - a medical condition that causes body temperatures to fall below normal levels; this condition leads to several critical health problems.
3. *Barotrauma* - A tissue or organ injury that happens due to an abrupt shift in air pressure.
4. *Decompression sickness* – the disease resulting from a change in pressure; also referred to as divers sickness.
5. *Hypoxia* - a condition in which there is not enough oxygen in the body causing dizziness or fainting.
6. *Post-Traumatic Stress Disorder (PTSD)* - A mental disorder that is caused by experiencing a traumatic event with symptoms of anxiety and sleep issues.
7. *UV radiation - ultraviolet radiation is an invisible part of solar radiation that has the potential to burn the skin and cause harm to the eyes.*
8. *IR Radiation* - invisible type of radiation that can cause body heating and damage to vision.
9. *Tendinitis* - inflammation of a tendon due to overuse, performing repetitive movements, or stressing the tendon beyond its capacity and causing pain, swelling, and stiffness of the affected tendons.
10. *Carpal Tunnel Syndrome* - a nerve problem that causes pain and numbness in the hands due to a pinched nerve at the wrist.
11. *Tennis Elbow (Lateral epicondylitis)* - a painful condition caused by overuse of the elbow muscles.
12. *Discopathy* - describes the condition in which spinal disc damage results in back pain.
13. *Burnout syndrome* - a condition of complete mental and physical exhaustion caused by prolonged stress at work.
14. *Cognitive tasks* - the notion that refers to a mental activity that needs processes like attention, memory, reasoning, problem-solving, decision-making and language comprehension.
15. *Circadian rhythm* - the biological clock of the human body that regulates the duration of the sleep and wake period in a day.
16. *Nerve compression syndrome* - a medical condition due to a long time of pressure on a nerve that causes pain, tingling, numbness and weakness in the affected area.
17. *Cognitive overload* - it is a condition, which occurs when an individual is overburdened with the amount of information he/she is able to process.