

Have older workers been overlooked by health and safety standards?

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Older workers represent a special group with characteristics that require specific attention from the Occupational Health and Safety point of view. International standardization might play an important role to ensure practical, efficient, and ethical implementation of solutions to contribute to a health and safe ageing workforce. Despite the recent establishment of the ISO Technical Committee 314 on Ageing Societies, there appears to be a general scarcity of recommendations specifically targeted to the ageing workforce in health and safety standards. The objective of this paper is to review international standards to identify and summarize the main guidelines related to OHS challenges for older workers. This “state of the art” picture helps recognizing and spreading existing recommendations in workplaces. It offers advice on how international standards can support establishing and developing an Occupational Health and Safety management system, and designing the workplace and working environment to support older workers. Finally, it pinpoints the main gaps that still need to be filled.

Keywords: Ageing workforce, Occupational Health and Safety (OHS), International standards, Older workers, Elderly, Ergonomics.

1. Introduction

Ageing workforce can be defined as “the increase in the number of older people in the workforce” (ISO 25550, 2022).

Due to the general ageing of the population and the higher average retirement age of workers, most developed countries are currently being affected by the workforce ageing phenomenon (Calzavara et al., 2020). In the United States, the number of people 75 and older in the labor force is expected to grow by 96.5 percent by 2030 (Bureau of Labor Statistics, 2021). In addition, population in developing countries is expected to be subject to ageing at three times the speed of

populations in developed countries over the next few decades (United Nations, 2020).

On the one hand, the benefits of older workers to the organization include (ISO 25550, 2022): reductions in absenteeism, turnover, recruitment costs; the synergy gained by linking new and existing skills of the workforce that could raise productivity and innovation; solving labor workforce shortages; improving the corporate image of the organization.

On the other hand, this phenomenon poses several challenges for working environments due to the age-related physiological and psychological changes that could affect older workers (Wisseman et al., 2022; ISO 25550, 2022).

In order to ensure healthy and safe conditions at the workplace, these changes should be carefully taken into consideration. Indeed, older workers represent a special group with characteristics that require specific attention from the Occupational Health and Safety (OHS) point of view (Varianou-Mikellidou et al., 2019).

International standardization might play an important role to ensure practical, efficient, and ethical implementation of solutions to contribute to a health and safe ageing workforce (Wissemann et al., 2022). However, people with special requirements generally fall outside the scope of most international standards, which are often valid only for people with characteristics that are frequently referred as “normal” or “typical” (ISO 28803, 2012). One reason for standards to have a restricted scope in terms of user population is that knowledge is incomplete for people who might have special requirements, like older people (ISO 28803, 2012). However, advice should still be provided to ensure accessible design of products, services and environments (ISO 28803, 2012).

International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) Guide 71 (2001, revised in 2014) represented a first attempt to fill this gap. It provides guidelines for standard developers to address the needs of older persons and persons with disabilities. However, the impression is that the expectations of ISO/IEC Guide 71 have been disattended by a large extent by OHS standard developers. That, even despite the recent establishment of the ISO Technical Committee 314 on Ageing Societies.

For this reason, the objective of this paper is to identify and summarize the main guidelines related to OHS challenges for older workers provided by international standards in order to provide a “state of the art” picture.

2. Methodology

Health and safety recommendations specifically targeted to the ageing workforce have been identified through a review of international OHS standards.

We analyzed the standard catalogues of ISO and the European Committee for Standardization (CEN). The catalogues have been browsed by the International Classification for Standards (ICS).

In particular, we considered the following groups and related sub-groups:

- 11.180 “Aids for disabled or handicapped persons (Including aids for elderly people)”;
- 13.040 “Air quality”;
- 13.100 “Occupational safety. Industrial hygiene”;
- 13.110 “Safety of machinery”;
- 13.140 “Noise with respect to human beings”;
- 13.160 “Vibration and shock with respect to human beings”;
- 13.180 “Ergonomics”;
- 13.340 “Protective equipment”;
- 91.160 “Lighting”.

In addition, we reviewed the standards prepared by the following Technical Committees (TC) and Subcommittees:

- CEN/SS F16 “Graphical symbols”;
- ISO/TC 145/SC 2 “Safety identification, signs, shapes, symbols and colours”;
- ISO/TC 314 “Ageing societies”.

Finally, we searched the whole catalogues using the following keywords: “ageing”, “elder”, “inclusive”, and “older”.

3. Results

The review of international standards led to the identification of a set of documents providing guidelines related to OHS of older workers. The full list of documents is provided in Table 1, along with their ICS code(s), and specification of the technical committee(s) in charge of their preparation.

Table 1. List of the retrieved international standards (in alphabetical order).

Standard	ICS	TC
EN 1005-2+A1:2008	13.110 13.180	CEN/TC 122
EN 1005-3+A1:2008	13.110 13.180	CEN/TC 122
EN 1005-5:2007	13.110 13.180	CEN/TC 122
EN 13861:2011	13.110 13.180	CEN/TC 122

Table 1 (Continued).

Standard	ICS	TC
ISO 10075-3:2004	13.180	ISO/TC 159/SC 1
ISO 11228-1:2021	13.180	ISO/TC 159/SC 3
ISO 11228-2:2007	13.180	ISO/TC 159/SC 3
ISO 11228-3:2007	13.180	ISO/TC 159/SC 3
ISO 12100:2010	13.110	ISO/TC 199
ISO 13732-1:2006	13.180	ISO/TC 159/SC 5
ISO 13732-3:2005	13.180	ISO/TC 159/SC 5
ISO 14738:2002+ Cor.1:2003+ Cor.2:2005	13.110 13.180	ISO/TC 159/SC 3
ISO 15537:2022	13.110 13.180	ISO/TC 159/SC 3
ISO 1999:2013	13.140	ISO/TC 43
ISO 24502:2010	13.180 11.180.30	ISO/TC 159/SC 5
ISO 24505:2016	13.180	ISO/TC 159/SC 3
ISO 25550:2022	03.100.30	ISO/TC 314
ISO 2631-1:1997+ Amd.1:2010	13.160	ISO/TC 108/SC 4
ISO 26800:2011	13.180 01.040.13	ISO/TC 159/SC 1
ISO 28803:2012	13.180	ISO/TC 159/SC 5
ISO 6385:2016	13.180	ISO/TC 159/SC 1
ISO 7029:2017	13.140	ISO/TC 43
ISO 8996:2021	13.180	ISO/TC 159/SC 3
ISO 9241-303:2011	13.180 35.180	ISO/TC 159/SC 4
ISO 9886:2004	13.180	ISO/TC 159/SC 5
ISO/IEC 10779:2020	35.260 11.180.99	ISO/IEC JTC 1/SC 28
ISO/TR 12295:2014	13.180	ISO/TC 159/SC 3

Table 1 (Continued).

Standard	ICS	TC
ISO/TR 22411:2021	01.120 11.180.30	ISO/TC 159
ISO/TS 20646:2014	13.180	ISO/TC 159/SC 3

The retrieved standards could be divided into two groups: standards specific for older persons or not specific for older persons.

3.1. Standards specific for older persons

We classified as standards specific for older persons those standards that, according to their Introduction and Scope sections, focus specifically on older persons as one of their user populations. These standards usually have in their title words like “age”, “ageing”, “age-related”, “people with special requirements”, “accessible”, “inclusive”, “older persons”.

Table 2 provides the list of elderly-specific standards identified as a result of our review and summarizes which main OHS domains and sub-domains are addressed by each document.

Table 2. OHS domains and sub-domains addressed by standards specific for older persons.

Standard	Domain: sub-domains
ISO 24502:2010	Design and assessment of the visual environment: luminance contrast in signs and displays.
ISO 24505:2016	Design and assessment of the visual environment: color combinations and their conspicuity in signs and displays.
ISO 25550:2022	Management of OHS for age-inclusive workforce: establishment and development of management system and programs, risk assessment, and ergonomic workplace design.

Table 2 (Continued).

Standard	Domain: sub-domains
ISO 28803:2012	Design and assessment of the thermal working environment: sensory impairment, impairment of vasomotor control, differences in metabolic rate, air temperature. Design and assessment of the acoustic environment: sound level of danger signals, auditory displays frequency range, intelligibility of speech communication.
ISO 7029:2017	Design and assessment of the acoustic environment: hearing threshold deviation.
ISO/IEC 10779:2020	Design and assessment of office equipment: accessibility.
ISO/TR 22411:2021	Design and assessment of products, systems, services, environments, and facilities: recommendations to account for sensory characteristics and capabilities (vision, hearing, touch, thermal sense), physical characteristics and capabilities (body size, movements, muscle strength and endurance), and cognitive characteristics and capabilities (attention, information processing, memory, language and literacy).

3.2. Standards not specific for older persons

We classified as standards not specific for older persons those standards that, according to their Introduction and Scope sections, are targeted to general population, but include also some recommendations specific for older persons.

Each recommendation could provide qualitative or quantitative type of advice. Qualitative advice usually consists of general principles, concepts and approaches, while quantitative advice offers practical guidance (e.g. tables, formulae, reference values) on how to deal with the health and safety of older workers population.

Table 3 and Table 4 summarize, respectively, the list of qualitative and quantitative recommendations provided by standards not specific for older persons.

Table 3. Qualitative recommendations provided by standards not specific for older persons.

Standard	Recommendations
EN 13861:2011	When designing a machinery, specify the limits related to the population that will use the machinery also in terms of age.
ISO 12100:2010	When designing a machinery and assessing machine-related risks, specify the use limits of the machinery by different persons characterized also in terms of age. When performing risk estimation, consider age as one of the human factors affecting risk.
ISO 10075-3:2004	When measuring and assessing mental workload, describe the test sample also in terms of participant/employee age.
ISO 13732-3:2005	When assessing cold surface contact risk, consider that the elderly have a longer reaction time than the younger.
ISO 14738:2002+ Cor.1:2003+ Cor.2:2005	When designing workstations at machinery, consider that older people may have restricted abilities to move parts of the body with effect on movement angles.
ISO 15537:2022	When selecting and using test persons for testing anthropometric aspects of industrial products and designs, consider age as one of the selection criteria.
ISO 2631-1:1997+ Amd.1:2010	When evaluating exposure to vibration, consider that age is one of the factors affecting human response to vibration.
ISO 26800:2011	When designing and evaluating tasks, jobs, products, tools, equipment, systems, organizations, services, facilities and environments, specify the target population (people for whom the design is intended) also in terms of age.

Table 3 (Continued).

Standard	Recommendations
ISO 6385:2016	When designing work systems, specify the target population (people for whom the design is intended) also in terms of age. Avoid impairing effects caused by work strain considering that it depends also on age.
ISO/TS 20646:2014	When optimizing musculoskeletal workload, characterize workers also in terms of age.

Table 4. Quantitative recommendations provided by standards not specific for older persons.

Standard	Recommendations
EN 1005-2:2003+ A1:2008	When designing a machinery involving manual handling, use the reference masses provided by the standard which are specific for the old population.
EN 1005-3:2002+ A1:2008	When designing a machinery demanding force exertion, calculate the age-specific (> 50 years) maximal forces following the procedure provided by the standard.
EN 1005-5:2007	When designing a machinery demanding repetitive handling at high frequency, to determine the force multiplier, adjust all 100% Maximum Voluntary Contraction (MVC) reference distribution functions to the demographic profile (age, gender) of the envisaged user population according to EN 1005-3.
ISO 11228-1:2021	When performing manual lifting and lowering risk assessment, use the age-specific (> 45 years) reference masses provided by the standard.
ISO 11228-2:2007	When performing manual pushing and pulling risk assessment, calculate the age-specific (> 50 years) force limits following the procedure provided by the standard.

Table 4 (Continued).

Standard	Recommendations
ISO 11228-2:2007	When performing manual pushing and pulling risk assessment, calculate the age-specific (> 50 years) force limits following the procedure provided by the standard.
ISO 11228-3:2007	When performing risk assessment of manual handling of low loads at high frequency, to determine the force multiplier, adjust all 100% Maximum Voluntary Contraction (MVC) reference distribution functions to the demographic profile (age, gender) of the envisaged user population according to EN 1005-3.
ISO 13732-1:2006	When assessing hot surface contact risk, use the table provided by the standard to determine contact periods for elderly people.
ISO 1999:2013	When designing and assessing the acoustic environment, use the formulae and databases provided by the standard to determine the hearing threshold levels associated with age.
ISO 8996:2021	When assessing the thermal working environment, determine the Maximum Working Capacity (MWC) and the maximum Heart Rate (HR _{max}) using the formulae provided by the standard that include age as one of the parameters. Use the table provided to determine the metabolic rate from hearth rate as function of age.
ISO 9241-303:2011	When designing and assessing electronic visual displays, use the figure, formulae, table and reference values provided by the standard to define the viewing distance, luminance contrast, image polarity and character height for older users.

Table 4 (Continued).

Standard	Recommendations
ISO 9886:2004	When evaluating the thermal strain due to the thermal working environment, if individual test is not possible, predict the limit of Heart Rate (HRL) and the sustained limit of Heart Rate (HRL _{sustained}) using the formulae provided by the standard that include age as one of the parameters.
ISO/TR 12295:2014	When performing risk assessment of manual handling and evaluating static working postures, consider the recommendations for older workers provided by ISO 11228-1, ISO 11228-2, ISO 11228-3.

4. Discussion

4.1. Standards specific for older persons

The results of our review show that there are only a limited number (7) of international standards specifically focusing on older persons and providing recommendations in the OHS field.

Among them, one (ISO 25550, 2022) offers mainly qualitative advice related to organizational issues for an age-inclusive workforce. Indeed, it recommends establishing and developing an OHS management system from the results of a risk assessment, taking into consideration older persons in the working environment. The recommendations can also be adopted in the existing OHS management system. In particular, being an age-inclusive organization means having policies, strategies, risk assessments focused on ageing workforce, along with mechanism in place to identify and address hidden ageism. This leads to prevention measures such as the following:

- flexible working hours arrangements especially for shift workers;
- flexible and individually tailored approach to work-life balance, especially for those experiencing health issues;
- opportunities to move to less physically demanding work, but at the same time helping older workers stay physically fit;
- considerations for user friendly and accessible technological approaches;

- information and counselling for life changes such as retirement.

In addition, ISO 25550 (2022) suggests organizations to design and re-design the workplace according to ergonomic principles to support older workers.

The other 6 standards specific for older persons provide quantitative type of advice.

ISO/TR 22411 (2021), which is the richest in content, is the oldest document, since its first edition dates back to 2008. It aims to provide ergonomics data related to human characteristics and capabilities of older people to be used by standard developers, but also by those responsible for design. It offers mainly recommendations to account for sensory and physical characteristics and capabilities of older persons. It tackles also some cognitive ergonomics issues, although it recognizes that data related to cognitive abilities are still missing.

The remaining standards specific for older persons providing quantitative type of advice deal with physical ergonomics issues, focusing mainly on the design and assessment of the thermal, acoustic, and visual working environments. Only one (ISO/IEC 10779, 2020) deals with the accessibility of office equipment.

4.2. Standards not specific for older persons

All the other standards identified in our review (22) include some recommendations specific for older persons, but are targeted to general population.

Among them, 10 provide only qualitative type of advice, usually recommending to characterize the target population also in terms of age or to consider age as one of the possible factors affecting risk. These standards should be applied mainly when designing a machinery or work systems and focus on the physical ergonomics domain. However, given the qualitative nature of the recommendation provided, they are of little help for practitioners looking for practical guidance on how to deal with the health and safety of the aging workforce.

On the contrary, the other 12 standards include quantitative type of advice, mainly in the form of tables, formulae, or reference values specific for older persons. They all focus on the physical ergonomics domain (e.g. manual lifting and lowering, manual pushing and pulling, force

exertion, thermal environment, acoustic environment and visual environment).

4.3. Final remarks

The results of this review confirm that only a few OHS standards are specific for older workers. Only a limited number of general standards provide practical advice to ensure accessible design of products, services and environments for people who might have special requirements, like older people, as advocated by ISO 28803 (2012).

Although ISO/TR 22411 (2021) has provided a thorough discussion of human characteristics and capabilities of older people intended to be useful for standard developers, it emerged that only a limited number of standards have taken advantage of those data. Therefore, it would be advisable to revise all the other OHS international standards to include some practical age-specific advice.

In terms of domains, the large majority of recommendations available refer to physical ergonomics, with only one document dealing with organizational ergonomics, and almost none standards dealing with cognitive ergonomics. As stated in ISO 28803 (2012), this is probably due to the amount of data currently available related to human characteristics and capabilities of older people. This calls for further investigation and collection of data especially related to the cognitive abilities of older persons.

Finally, the recommendations currently available concern mainly with occupational health rather than safety at work. Indeed, over 75% of the reviewed standards are classified as belonging to ICS 13.180 “Ergonomics”, and also the 24% belonging to a safety-related ICS (i.e. ICS 13.110 “Safety of machinery”) deal only with physical ergonomic issues. Recommendations related to other safety issues, e.g. personal protective equipment, are missing. Ultimately, it is alarming that the majority of safety-related standards completely overlook the specificity and needs of the aging workforce. An effort to fill this gap is urgently required.

5. Conclusions

In this paper a review of international standards has been performed to identify and summarize the main guidelines related to OHS challenges specifically targeted to the ageing workforce.

The results of this study have both theoretical and practical implications.

On the theoretical side, this research pinpoints the main gaps in the content of international standards, and highlights directions for future research needed to fill such gaps.

On the practical side, this “state of the art” picture helps recognizing and spreading existing recommendations in workplaces. Indeed, it provides practitioners with advice on which standards to consult to find guidance on how to ensure healthy and safe conditions to the older workers in their organizations.

However, this work is not without limitations. In particular, some relevant standards might have been overlooked as a result of the searching criteria and methodology adopted. Further research could extend the set of ICS and keywords considered. In addition, an approach similar to that applied in this research could be adopted to investigate the availability of age-specific recommendations in other work-related domains, e.g. quality of working life, knowledge management, and training.

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