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AGE AND GENDER DIFFERENCES IN WORK ABILITY AMONG INDUSTRY WORKER: THE FOUNDATION FOR SAFETY INTERVENTION DESIGN

CLÁUDIA FERNANDES

CATIM – Technological Center for the Metal Working Industry ,Rua dos Plátanos, 197,4100 – 414 Porto, Portugal. Telefone 00351 226 150 000, fax 00351 226 150 036. UA – University of Aveiro, Aveiro – Portugal

E-mail: claudia.fernandes@catim.pt (corresponding author)

ANABELA PEREIRA

UA – University of Aveiro, Aveiro – Portugal

PEDRO BEM-HAJA

UA – University of Aveiro, Aveiro – Portugal

VÂNIA AMARAL

UA – University of Aveiro, Aveiro – Portugal

CARLOS F. SILVA AUTHOR

UA – University of Aveiro, Aveiro – Portugal

ABSTRACT

The paper explores and analyses the age and gender differences relating work ability in active workers from the Portuguese industry, aiming to achieve general trends that allow the industrial safety design to be based on evidence from research. It were encompassed 621 workers (386 men and 235 women) with ages between 20 and 65 years old. It was used the Work Ability Index (WAI) to measure the individual work ability (WA).

The data show that generally the WAI decreases with age, and data visual analyses suggests that there are some periods in life that differences between genders are more pronounced. The workforce vulnerability age bands identified according to gender are: i) 25-34; ii) 40-44 and iii) 60-64.

The main reasons for work absence and its duration between genders are also distinct according to the age band in analyses. The men propensity is higher for accidents that lead to lesions in legs/foots and upper limbs, and on the other hand women show more back injury from accident and musculoskeletal injuries related to work and are diagnosed more commonly with slight mental disorders or problems (for example, slight depression, tension, anxiety, insomnia). If we look into the absence to work duration, there are some patterns that are different between genders, e.g. absence superior to 100 days per year are only present in women in the bands 25-34 and 40-44; on the age band 40-44, 33% of the women have from 1 to 24 day absence per year and men 28%, 67% of the women and 72% of the men didn't miss work. Some of the trends identified might be consistent with maternity leave and family support, accident and sickness vulnerability. General directions for maximizing industrial safety interventions results arise and are discussed in this study, namely the resilience engineering approach aiming the design of healthy workplaces.

Work ability, Safety intervention design, Resilience engineering, Healthy workplaces, Work-life balance

1. INTRODUCTION

Aging is a disruptive force in many economies and countries worldwide. A curious fact is that there are more walkers and wheelchairs than baby carriages in some parts of Europe (MIT, 2011). There are a growing number of aging persons (European Union, 2010) and displaced workers in the manufacturing industries all across Europe (Manufuture, 2006), the women participation in industry has also increased since the II World War. Work ability (WA) is a dynamic multi-faceted, multi-determined construct, and also an individual characteristic that has been systematically and negatively correlated with age, but systematically and positively correlated with quality of work-life, quality of life, productivity and general well-being (e.g. Gould et al, 2008; Hernandez & Romero, 2010; Jung at al., 2010; Holtermann et al., 2010, Ilmarinen, 2001; Ilmarinen et al., 2005). Studies also show that WA is associated with health, competence, values, work environment and social relations (Gould at al., 2008). The level of WA in the working population can predict both future permanent disability and sick leave absences (Ilmarinen, 2012) and the agreement with clinical diagnosis is good (Eskelinen et al., 1991).

During the working lifespan men and women engage on different roles either at home or at work (Allen, 2012). Demands such as dependent caregiving (descendent and ascendant), follows a development pattern that might be consistent with the chronological age. Can these interactions between age and gender be reflected on WAI of employed workers from the industry?

Best practices in health and safety management or in the promotion of healthy workplaces are usually prescriptive and have principles that are implicit, however, since the principles underlying the management practices are not known, it becomes harder to maintain health and safety management systems that are continuously adequate for the changes in the socio-technical system in which the organization is located (Saurin & Júnior, 2011; Reiman and Oedewald, 2009).

A resilient approach to working settings allows dealing with not only the variability of the context but also individual variability across the lifespan.

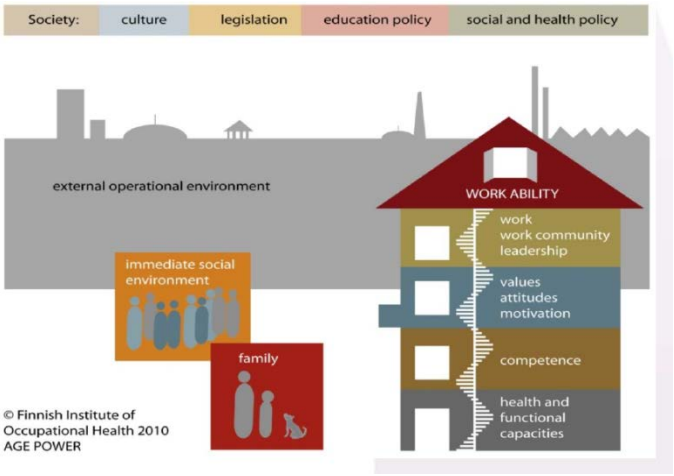
1.1 Work Ability

EU-27 working age population trends indicate that the age group 55-64 will expand by about 16,2% (9.9 milion) between 2010 and 2030, all the other age groups are declining (EUROSTAT, 2011). This means that Europe will have the older workforce ever.

Recently the Finnish Institute of Occupational Health (FIOSH) suggested a renewed approach to WA and suggested the WA House model (see figure 1) has the basis for intervention. This model suggests that there are four floors at different levels:

- 1st floor – “Health and functional capacities” – Health promotion: includes lifestyle habits (e.g. eating, drinking, smoking, physical activities, sleep, recovery), dealing with acute and chronicle diseases. Aging and general health issues should also be covered (Ilmarinen, 2012).
- 2nd floor – “Competence” – Maintaining professional competence: continues updating of skills and competencies. The training design (on-the job, action-training) allows different learning styles to be taken in account. Learning during aging is an important success factor for active aging (Ilmarinen, 2012, p. 5).
- 3rd floor – “Values, attitudes and motivation”.
- 4th floor – “Work, work community, leadership”: consists on the work environment and its components, e.g. physical, mental and social.

Figure 1. FIOH Work Ability house model



Work ability tends to decline with age, although the mean values for the working population from 20 to 65 years remain in the categories good or excellent. Individual differences and variability in WAI grows with age (Ilmarinen, 2012). WA is an important indicator not only for research purposes but also for industry' decision makers and industrial practitioners (Fernandes et al., 2012; Fernandes, 2011) due to its practical implications and predictability for future workers' WA.

It's important to stress that WAI is not an indicator of health, functional capacity or employability. This misconception neglects the fact that WAI reflects the quality of the interactions between work, the environment and the worker (see house WAI model).

1.2 Work-life balance gender and age

According to DTI (2001, p. 5) "work-life balance isn´t only about families and childcare. Nor is it about working less. It's about working 'smart'. About being fresh enough to give all you need to both work and home, without jeopardising one for the other. And it's a necessity for everyone, at whatever your stage in life." Research shows that lack of work-life balance (work and non-work activities) is related with poor or reduced psychological and physical well-being (DTI, 2001; Sparrow et al., 2010). It´s suggested that Work-Life Balance (WLB) policies should be situation specific and take in account factors has type of employment (e.g. self-employed, agency workers, organizational employee), type of work (physical, mental or both), type of industry and sector of activity, gender, age, and ethnicity. The literature suggests that the main influences on WLB are: the increasing number of women in the active labour force; the increasing number of women in the active labour force with dependent children; the majority of women return to full paid employment after childbirth; the changing nature of families (e.g. mono-parental families); emigration and immigration phenomenon's; increased life-expectancy; elderly related responsibilities; trends for starting a family later in life (women mean age for first child birth in 2010 for Portugal was 29 years, (Pordata, 2011)).

We can easily defend that WLB intervention aren´t only for employees with depend children, are also for: i) employees that need to balance their work and leisure activities; ii) employees with dependent elderly relatives; iii) employees balancing their work with further education.

1.3 Resilience engineering

The term resilience has been widely used and applied in diverse fields of study and intervention from engineering to social sciences, from industrial practice to clinical intervention. It would be misleading to portray resilience engineering (RE) as radically innovative (Saurin & Júnior, 2011). On the other hand the articulation and the interactions between RE theory, individual concepts and principles allied to the contextualization and field application might be a wider contribution. In fact, the process of re-interpreting best practices is recognized has having outputs in the RE field and conceptualization (Hollnagel, 2008).

So in general terms and according to the literature resilience is the intrinsic ability of a system to adjust tis functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions (Dekker et al., 2008; Eurocontrol, 2009; Hollnagel, 2008).

According to Dekker and colleagues (2008) people, at all levels of an organization create safety through practice. So safety is not about the absence of something, it is about the presence of something. RE allows to understand and enhance how people themselves build, or engineer, adaptive margin into their system, how they create safety — by developing capacities that help them anticipate and absorb pressures, variations and disruptions (Dekker et al., 2008; Eurocontrol, 2009; Hollnagel, 2008).

1.4 Designing for safety

Industrial plants are complex sociotechnical systems characterized by specialization, tool mediated nature of the work, technological complexity, in constant actualization and facing emergent procedures and technologies (e.g. nanotechnologies, nanomaterial's, advances in manufacturing) operating with complex social structures and subject to emerging psychosocial risks and the changing nature of work and general environment. Nowadays industrial plants must satisfy diverse goals, such has effectiveness, productivity, financially safe, sustainability, environmental friendly. And it must also ensure personal and societal well-being. The goals are balanced with the available resources. So, we can draw different scenarios were there are lack of resources e.g. financial and the impact on everyday work environment.

When considering safety and well-being as an emergent property of the functioning of a sociotechnical system has an organization or an industrial plant (in context), the role of intervention design and evaluation gets more complicated and yet more important. When deciding on the focus of the design one needs to balance between focus on details and oversight of the entire organization in the process (Reiman and Oedewald, 2007, 2009). The approach is influenced in many ways and in differentiated ways for example, by the paradigm underneath, the resources available, time pressures, among others.

1.5 Healthy workplaces

Health is a state of complete physical, mental and social well-being, and not merely the absence of disease and infirmity (WHO, 1948). Having a healthy, balanced life can seem difficult due to the general context: aging workforce, long working hours, new ways of working, temporary working, lack of exercise, pour diet, exposure to psychosocial factors, shift work, team work, work pressures and demands, economical context, changing nature of families, work-life balance, among others. Factors related with WAI scores along the lifespan (Imarinen, 2012), management styles and safety design approaches.

Much needs to be done, so that we can assure that work remains a healthy and positive experience for workers through their "expanded" career trajectory (Lindberg and Vingard, 2012), and it does not damage their health (Griffiths, 2000) and well-being. Work should also be able to promote equity and fairness in society.

2. METHOD

The authors will focus on the industry sample (n=621; 14,9%), that is a part of a larger sample (n=4162; 100%).

Table 1. General sample

	Male	Female	Total	%
Industry	386	235	621	14,9
Teaching	115	205	320	7,7
Services/ trade	373	221	594	14,3
Health	273	804	1.077	25,9
Public Administration	167	227	394	9,5
Police forces	825	112	937	22,5
Others	98	121	219	5,3
	2.237	1.925	4.162	100,0

The data were collected in industrial settings, encompassing 621 active workers, (235) 38% women and (386) 62% men, with a mean age of 39 years old (min. 20; Max. 65; SD 10,97). The data were collected by survey that consisted in the Work Ability Index (WAI) with a purposefulness sample. In the industry sector the response rate was 90%.

2.1. Work Ability Index

Work Ability (WA) was evaluated by the WAI on its Portuguese official validated version (Silva, 2011; Silva at al., 2000), original version from the Finnish Institute of Occupational Health (FIOH). WAI is a subjective survey instrument that consists of seven items:

I. Current WA compared with the lifetime best [0-10];
II. WA in relation to the demands of the job [2-10];
III. Number of current diseases diagnosed by a physician [1-7];
IV. Estimated work impairment due to diseases [1-6];
V. Sick leave during the past year (12 months) [1-5];
VI. Own prognosis of WA 2 years from now [1-7];
VII. Mental resources [1-4].

The WAI scores range from 7-49, and are classified into poor [7-27], moderate [28-36], good [37-43], excellent [44-49]. According to the WAI score achieved different actions must be taken to prevent decline, improve or to maintain a good level of WAI.

2.2 Data analyses

WAI data are categorized into: poor (7-27 points), moderate (28-36 points), good (37-43 points) and excellent (44-49 points), according to the WAI methodology and international quoting principles. The sample was stratified by gender (female, male) and age according to the following age bands: a) 20-24; b) 25-29; c) 30-34; d) 35-39; e) 40-44; f) 45-49; g) 50-54; h) 55-59; i) 60-64.

The statistical analyses were made with the software Statistical Package for Social Sciences (SPSS) version 19.

2.3 Ethical aspects

All the participants agreed in the participation on this research by informed consent. The data are confidential and used only for research purposes.

3. RESULTS

It were computed the WAI reference values for each gender and age band. If the age band in analyses had less than 2 individuals the results were not considered (e.g. age band [65-69]).

Table 2. WAI reference values for the industry sample.

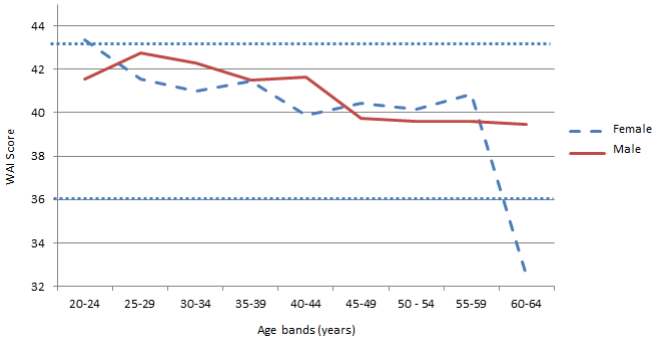
	Male		Female	
	Mean	Standard Deviation	Mean	Standard Deviation
20-24	41,56	4,60	43,33	4,31
25-29*	42,74	4,51	41,55	7,42
30-34*	42,28	6,79	41,00	5,80
35-39	41,51	5,19	41,45	4,74
40-44*	41,64	5,27	39,86	6,62
45-49	39,73	5,73	40,43	4,38
50-54	39,62	5,62	40,14	5,65
55-59	38,11	6,54	40,83	7,04
60-64*	39,44	4,64	35,50	7,78
65-69	-	-	-	-

* Age band in analyses

Generally WAI decreases with age, but according to data visual analyses the differences between genders are pronounced in three age bands where the standard is not uniform: i) 25-34: ii) 40-44; iii) 60-64. Female gender individuals are more vulnerable to WAI decrease in these age bands. In spit that between 44 and 60 years women recover more easily and denote higher WAI scores than men (see figure 3).

We analyzed also the main diseases and/or disorders with medical diagnosis reported by the workers, and that are on the basis for the WAI decrease (see table 3).

Figure 3. WAI scores according to age bands



The main reasons for work absences and duration are also distinct according to gender and age band in analyses. We will focus on the 3 vulnerability age bands identified according to the WAI scores i) 25-34: ii) 40-44; iii) 60-64.

Table 3. Vulnerability age bands and major four diseases/disorders with medical diagnosis

	Female	Male
Age band [25-34]	14,3% sinusitis and chronicle rhinitis (WAI 18) 12,2% slight mental disorder (WAI 24) 11,2% back injury from accident (WAI 1) 10,2% lower back disorder with frequent pain (WAI 6)	5,7 % sinusitis and chronicle rhinitis (WAI 18) 4,9% slight mental disorder (WAI 24) 4,9% back injury from accident (WAI 1) 4,9% % lower back disorder with frequent pain (WAI 6)
	n=98	n=122
Age band [40-44]	42,9% lower back disorder with frequent pain (WAI 6) 28,6% upper back and neck disorder with frequent pain (WAI 5) 23,8% rheumatism and articulation pain (WAI 9) 19% slight mental disorder (WAI 24)	17,9% upper limb injury from accident (WAI 2) 15,4% slight mental disorder (WAI 24) 12,8% lower back disorder with frequent pain (WAI 6) 12,8% upper and lower limbs disorder with frequent pain (WAI 8)
	n=21	n=39
Age band [60-64]	100% upper limb injury from accident (WAI 2) 100% rheumatism and articulation pain (WAI 9) 100% hypertension (WAI 11) 50% slight mental disorder (WAI 24)	22,2% hypertension (WAI 11) 22,2% Renal disease (WAI 36) 22,2% upper and lower limbs disorder with frequent pain (WAI 8) 11% slight mental disorder (WAI 24)
	n=2	n=9

3.1. Age band [25-34]

In the age band [25-34] it's denoted a decrease in WAI for female individuals, and data visual analyses denotes differences between genders that reflects in the general WAI scores, nevertheless the scores are considered good or excellent.

Sinusitis and chronicle rhinitis are only present on this age band for both genders, but more prevalent on women. Lower back disorder with frequent pain is also present on both genders (10,2% ♀; 4,9% ♂). In this age band only women present absences to work superior to 100 days per year.

3.2. Age band [40-44]

A similar decrease to the one on the age band [25-34] is denoted in this age band [40-44] concerning the WAI scores.

Both gender present lower back disorders with frequent pain (42,9% ♀; 12,8 % ♂).

In this age band 33% of women have 1 to 24 days per/year absence, 72% of men and 67% of the women didn't miss a single day work last year in analyses.

3.3. Age band [60-64]

In this age band the differences between men and women concerning WAI scores and diseases/disorders more prevalent with medical diagnostics are very different. All of the women in our sample had upper limbs injury resulting from accident, pain resulting from rheumatism and articulations and hypertension. Half of the women have a diagnosis of slight mental disorder. Although there is a great decline in women's' WAI, when compared to men the value must be seen has relative, since the sample for this age band only had 2 women.

3.4. General trends

When we look at the main diseases/disorders with medical diagnosis for these vulnerability age bands (four with higher frequency, see table 3):

i. *Slight mental disorders*, such as slight depression, tension, anxiety, insomnia or difficulties in sleeping are present and increase with age when we look at the female group, it's also present on all the age bands and the two genders ([25-34] 12,2 % ♀; 4,9 % ♂; [40-44] 19 % ♀; 15,4 % ♂; [60-64] 50 % ♀; 11 % ♂). The prevalence on the women goes from 12,2% to 19% to 50% when we start going up the age bands, and in the case of men goes from 4,9%, to 15,4% and 11%. The prevalence is higher on the women group but we must stress that this disorder appears has one that encompasses more workers along the life-span.

ii. *Sinusitis and chronicle rhinitis* is very common on the age band 25-34, and with higher incidence on the female gender, but it tends to loose importance along the life-span.

iii. *Disorders on lower back* are very frequent on both genders, in spite of the higher frequency when we are looking at the female group, e.g. 42,9% of women on the age band [40-44] have a medical diagnosis versus 12,8% for the men.

iv. *Hypertension* frequency rises with the chronological age and is only present on the last age band [60-64] for either men (22,2%) or women (100%).

v. *Rheumatism and articulation* pain with medical diagnosis increases with age with special focus on the female gender.

vi. *Musculoskeletal disorders* are a reality in industry workers, namely for workers with ages from 40 and upper, has shown in the main disorders for the age bands [40-44] and [60-64]. See, for example, the frequencies for lower back disorder with frequent pain ([40-44] 42,9 % ♀; 12,8 % ♂; [60-64] 50%♀), upper and lower limbs disorder with frequent pain ([40-44] 19% ♀; 12,8 % ♂; [60-64] 50% ♀; 22,2% ♂), rheumatism and articulation pain ([40-44] 23,8 % ♀; 5,1 % ♂; [60-64] 100% ♀; 11,1% ♂), upper back and neck disorder with frequent pain. There are some disorders more prevalent on the female gender such has rheumatism and articulation pain ([40-44] 23,8 % ♀; 5,1 % ♂; [60-64] 100% ♀; 11,1% ♂).

vii. Disorders on upper or lower limbs are also very common on industry workers, many related with accidents and its consequences.

viii. Male gender has a higher prevalence of diseases and/or disorders with medical diagnosis due to accident.

4. DISCUSSION

The sample is fairly large (621 active workers), when separated by age-bands and within it by gender the stratified sample size does not have the required size for performing precise statistical test analyzes, namely the age band [60-64] (e.g. [25-34] n= 98 ♀; n= 122 ♂; [40-44] n= 21 ♀ ; n= 39 ♂; [60-64] n= 2 ♀ ; n= 9 ♂).

As has been previously stressed statistical tests for analyzing the differences were non-significative, the patterns that arise from our data are pronounced and deserve discussion and attention. The differences in WAI scores between genders according to the different age bands are consistent with different roles that are embraced out of work, namely dependent caregiving either for young children or elderly parents, and if we look at the median age for women to age the first child, that for Portugal (data from 2010; Pordata, 2011) is 29 years, this figure might be aligned with our data and the lowering of WAI for women in the age band [25-34].

The vulnerability age band [40-44] calls attention to the musculoskeletal disorders related to upper and lower limbs with associated pain, many related with work (e.g. nature, design, postures, new technologies, new/renewed work methods). Work-related musculoskeletal disorders include a wide range of disorders that have been associated to different work conditions (Punnet and Wegman, 2004; Van der Beek and Frings-Dresen, 1998). Research shows that worldwide (e.g. Canadá, Finland, Sweden, USA) these lesions cause more absenteeism and loss of work ability than any other group of disorders (Punnet et al., 2004). The nature of work activity seems to be determinant to the development of pain, medical restrictions, absenteeism and work impairments (Figueira, 2011; Punnet and Wegman, 2004; Van der Beek and Frings-Dresen, 1998).

The data concerning diseases/disorders for women on the vulnerability age band [60-64] might be related with the natural age and menopause, where women loose the natural defences from estrogen. Estrogen has a role in many body functions, namely skin tension, making bones stronger, protective effect concerning arteriosclerosis and have important effects on blood vessels (Atkinson et al., 2004; Burdette, et al., 2002; Cauley et al., 2003).

Slight mental disorder, such as slight depression, tension, anxiety, stress, insomnia or difficulties in sleeping is present in all age bands, and genders and increase its incidence with age. The difficult context in which industry operates and the global economic setting might be on the root of some of these problems. The European Commission (2008) aware of these problems published the European Pact for mental health and well-being where it identifies and calls for action in five areas, namely work. It recommends the improvement of work organisation, organisational cultures and leadership practices to promote mental well-being at work, including the reconciliation of work and family life (European Commission, 2008).

Although age is an important trend concerning WAI, namely older workers (> 55 years), there are other vulnerable age bands were WAI decreases and makes workers less able and the differences between genders are more pronounced [25-34] and [40-44]. Our data call attention to the fact that lifespan management (not only age management and looking for older workers, but looking for vulnerable age-bands) in the workplace can be an important issue for maintaining and/or promoting WAI. Looking at the workers and the lifespan course can be useful for designing health and safety interventions or implementing measures to cope with different life-situations that are gathered in some age bands such has: motherhood, taking care of dependents (either children or elderly people), going back to school (for post graduate degree or skills/competence actualization), having small children, societal participation and civic movements (DTI, 2001; Griffiths, 2000; Lindberg and Vingard, 2012; Sparrow et al., 2010; Anttonen and Räsänen, 2008), disease and/or disorder prevalence, disease and /or disorders vulnerability.

The inclusion of the resilience engineering principles in the intervention for healthy workplaces design must be taken in account so that this huge variability in context and in multiple levels (individual, organizational, societal, etc.) are managed and used for the best common purpose.

5. CONCLUSIONS

Industry is now facing multiple challenges not only due to globalization, economic settings but also demographics and emerging (and unknown) trends. The ability to cope and to make the best out of the situations must be grounded on solid research and having in mind that there are several unknown trends that affect workers life (in and out of work).

Multiple role engagement occurs along the lifespan and is likely to vary according to gender and age band in analyses, bringing into sharp relief the importance of research to support health and safety intervention design in the workplace. The major diseases/disorders with medical diagnoses evolve with age and are different according to genders. Some trends related to mental health, musculoskeletal disorders and work life balance call

for a life-span management policy (rather than a simple age management policy) and should apply to "healthy" workplaces design, management and evaluation.

It's our belief that healthy and safe workplaces must be able to proactively and systematically evaluate, manage and adapt their activities instead of focusing uniquely on risk control and barriers or one of the system components (e.g. individual, risk, organization, society). Eliminating sources of variability is not an effective and sufficient strategy on the long run. It's in itself necessary and normal for individuals and organizations to be able to deal with complexity either for success or failure. The challenge is to manage this variability and make the best out of it.

There is the need for policies that cope with work-life balance and look at the lifespan cycle that deal with gender and age differences in WA but also with vulnerable age bands has the ones identified on this study. Being able to take work life balance and WA in account when designing healthy and safe workplaces, aiming to promote well-being and integration along the workers lifespan, is a matter of fairness for all and preparing a sustainable future and a fairer society.

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