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Challenges and Pathways for Socio-occupational Reintegration Following an Occupational Accident

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Challenges and Pathways for Socio- occupational Reintegration Following an Occupational Accident

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Aos meus pais.
Ao Paulo, ao Miguel e ao Francisco.

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ORIGINAL PUBLICATIONS

This PhD thesis includes original papers published or submitted for publication in peer-reviewed journals. The complete list of publications is presented below. The articles under evaluation are marked with (*).

Paper 1

Almeida I, Teixeira JM, Magalhães T. The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution. *Journal of Forensic and Legal Medicine*. 2022; 90:102391. doi: 10.1016/j.jflm.2022.102391.

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Paper 2

Almeida I, Teixeira PM, Teixeira JM, Magalhães T. Relationship between psychological symptoms and professional reintegration after an occupational accident: a Portuguese cross-sectional forensic study. *Forensic Sciences Research*, 2026, Vol. 11, Issue 1. Doi:10.3788/tfsr20250001.

Indexed in Web of Science – JCR 2025 impact factor: 1.8.

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Paper 3 (*)

Almeida I, Teixeira PM, Teixeira JM, Magalhães T. Quality of Life Post- Occupational Accident. A Reintegration and Forensic Approach.

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LIST OF ABBREVIATIONS

OA	Occupational Accident
PIA	Personal Injury Assessment
WHO	World Health Organization
ILO	International Labour Organization
EU-27	European Union
PD	Permanent Professional Disability
PR	Professional Reintegration
NILMFS	National Institute of Legal Medicine and Forensic Sciences
3-DM	Three-dimensional methodology
TTPD	Temporary Total Professional Disability
TPPD	Temporary Partial Professional Disability
PAD-RW	Permanent Absolute Disability for Regular Work
PAD-AW	Permanent Absolute Disability for Any Work
HRQoL	Health-Related Quality of Life
IS	Injury Severity
IHA	Inventory for Handicap Assessment
DC	Damage Coefficient
WSAS	Work and Social Adjustment Scale
GAD-7	Generalized Anxiety Disorder Questionnaire
PHQ-9	Patient Health Questionnaire
RSA	Resilience Scale for Adults
SF-36	36-Item Short Form Survey
ICF	International Classification of Functioning, Disability and Health
SPSS	Statistical Package for Social Sciences

RESUMO

As lesões resultantes de acidentes de trabalho constituem um problema de saúde pública, para além de um problema social e económico. Os seus impactos podem ser sentidos, de forma temporária e/ou permanente, em várias dimensões de vida dos trabalhadores acidentados e das suas famílias (pessoal, social, económico, familiar e profissional), com impactos na sua qualidade de vida. As consequências, físicas e/ou psicológicas, decorrentes do acidente podem afetar não apenas a capacidade funcional do acidentado, mas impactar a sua capacidade de trabalho e de ganho. Sendo o trabalho uma dimensão tão estruturante da vida, a nível pessoal, familiar e económico, o afastamento do trabalho pode provocar uma perda de sentido de utilidade, de propósito de vida, e de contextos de participação social, que podem conduzir à instabilidade emocional e financeira, e ao isolamento social, especialmente se demasiado prolongado. Neste contexto, a promoção da reintegração socioprofissional o mais precocemente possível, não sendo uma tarefa fácil, deve constituir-se como o objetivo central no tratamento e reabilitação do acidentado. Neste sentido, o conhecimento dos fatores relacionados com processos de retorno ao trabalho bem-sucedidos é fundamental para o desenho de respostas de tratamento e reabilitação que tenham a pessoa como objeto, e a maior restituição possível da funcionalidade do acidentado, e consequentemente da sua capacidade de trabalho, como objetivo.

O objetivo geral desta investigação é fornecer evidências sobre as variáveis que estão relacionadas com a reintegração socioprofissional após um acidente de trabalho, de modo a apoiar os serviços, e os profissionais de recuperação, reabilitação e reintegração no desenvolvimento de avaliações e intervenções com vista a alcançar resultados mais eficazes. Os objetivos específicos são: (a) refletir sobre o papel que a avaliação de dano pessoal pode ter na promoção da reintegração profissional, especialmente nos casos mais severos; (b) analisar a relação entre os sintomas psicológicos no momento da primeira avaliação de dano pessoal e dois resultados do processo: a reintegração profissional e a incapacidade profissional permanente; (c) analisar os efeitos dos fatores pessoais, da severidade da lesão resultante do acidente, da incapacidade profissional, e do estado da reintegração profissional na qualidade de vida relacionada com a saúde do acidentado.

Para alcançar esses objetivos foram realizados três estudos. O primeiro consistiu numa análise retrospectiva, usando uma amostra de conveniência de casos severos de acidentes de trabalho. Usando como base a análise dos relatórios de avaliação de dano pessoal realizados relativos a: (a) parâmetros de dano profissional permanente homologados em sede de Tribunal de Trabalho, e (b) avaliação de follow-up do dano pessoal e os ajustes de necessidades pessoais de apoio. O segundo estudo seguiu uma metodologia transversal, utilizando uma amostra de conveniência de casos gerais de acidentados de trabalho, e analisou a relação entre os sintomas psicológicos (dor emocional, ajustamento profissional e social, depressão e ansiedade) avaliados no momento da primeira avaliação de dano pessoal, na companhia de seguros, e a sua relação com a reintegração profissional e com a incapacidade profissional. O terceiro estudo, que teve o mesmo desenho metodológico e versou sobre a mesma amostra que o anterior, avaliou a relação entre a qualidade de vida relacionada com a saúde e os fatores pessoais, a severidade da lesão, a incapacidade profissional, e a reintegração profissional.

Os resultados evidenciam que: (a) nos casos severos a avaliação com base na metodologia tridimensional está relacionada com a atribuição de incapacidade permanente parcial para o trabalho, e para a atribuição de incapacidade permanente absoluta; mas não com a incapacidade permanente absoluta para o trabalho habitual; (b) nos casos severos observamos que, apesar de 67 acidentados terem sido considerados capazes de retomar a atividade profissional, apenas 31 efetivamente o fizeram; (c) na amostra de casos gerais a maioria apresenta sintomas psicológicos em grau igual ou acima do moderado, sendo que os acidentados não reintegrados profissionalmente exibem sintomas de maior severidade do que os reintegrados; (d) na amostra de casos gerais a qualidade de vida relacionada com a saúde é mais baixa do que a observada na população Portuguesa, e principalmente mais baixa, em quase todas as suas dimensões, nos profissionais não reintegrados profissionalmente, embora com significância estatística apenas em duas dimensões.

Estes resultados evidenciam a importância de abordagens multi e interdisciplinares no processo de reabilitação e reintegração profissional dos acidentados de trabalho. Além disso, evidenciam a complexidade do processo, e a necessidade de avaliações e intervenções que consigam integrar a relação entre o resultado das lesões, as capacidades individuais preservadas e os contextos e tarefas profissionais de cada uma das pessoas dado que é a elas que se pretende que voltem o mais cedo possível.

ABSTRACT

Occupational accidents constitute a public health, social, and economic problem. Their impacts may be felt, temporarily and/or permanently, across multiple dimensions of injured workers' and their families' lives (personal, social, economic, family, and professional domains), with consequences for their quality of life. The physical and/or psychological consequences that may arise from an occupational accident can affect not only the injured worker's functional capacity, but also his/her work and earning capacity. Given that work is such an important dimension of life at the personal, family, and economic levels, absence from work, especially if prolonged, may lead to a loss of sense of usefulness, purpose in life, and opportunities for social participation, which may in turn result in emotional and financial instability, and social isolation. In this context, the promotion of socio-professional reintegration as early as possible, although not an easy task, must constitute the principal objective of the treatment and rehabilitation of injured workers. Accordingly, knowledge of the factors associated with successful return to work processes is essential for the design of treatment and rehabilitation responses that place the person at the centre and aim to achieve the greatest possible restoration of the injured worker's functionality and, consequently, work capacity.

The overall objective of this research is to provide evidence on the variables associated with socio-professional reintegration following an occupational accident, in order to support recovery, rehabilitation, and reintegration professionals in the development of assessments and interventions aimed at achieving more effective professional outcomes. The specific objectives are: (a) to reflect on the role that personal injury assessment may play in promoting professional reintegration, particularly in more severe cases; (b) to analyse the relationship between psychological symptoms at the time of the first personal injury assessment, conducted at an insurance company, and two process outcomes: professional reintegration and permanent professional disability; and (c) to analyse the effects of personal factors, occupational injury severity, permanent professional disability, and professional reintegration status on injured workers' health-related quality of life.

To achieve these objectives, three studies were conducted. The first consisted of a retrospective analysis using a convenience sample of severe occupational accident cases, based on the analysis of personal injury assessment reports relating to: (a) parameters of permanent professional damage homologated at the Labour Court, and (b) follow-up personal injury assessments and adjustments to personal support needs. The second study adopted a cross-sectional methodology using a convenience sample of general cases and analysed the relationship between psychological symptoms (emotional pain, occupational and social adjustment, depression, and anxiety), assessed at the time of the first personal injury assessment, conducted at the insurance company, and their association with professional reintegration and professional disability. The third study, which followed the same methodological design and was conducted with the same sample, examined the relationship between personal factors, injury severity, professional disability, professional reintegration, and health-related quality of life.

The results show that: (a) in severe cases, assessment based on the three-dimensional methodology was associated with the attribution of permanent partial work disability and permanent professional disability for any work, but not with permanent professional disability for the regular work; (b) in severe cases, although 67 injured workers were considered capable of returning to work, only 31 were effectively professionally reintegrated; (c) in the general sample, most injured workers showed psychological symptoms at a moderate or higher level, and non-reintegrated workers exhibited more severe psychological symptoms than those who were professionally reintegrated; and (d) in the general sample, injured workers health-related quality of life was lower than Portuguese population norms, and was lower, across almost all its dimensions, among workers who were not professionally reintegrated, although with statistical significance limited to two domains.

These findings highlight the importance of multi- and interdisciplinary approaches in the rehabilitation and professional reintegration process of occupationally injured workers. They further underscore the complexity of this process and the need for assessments and interventions capable of integrating the relationship between injury outcomes, preserved individual capacities, and their professional contexts and tasks, given that the aim is to promote their return to these contexts and tasks as early as possible.

I. GENERAL INTRODUCTION

1. Occupational accidents

Work plays a central role in individuals' lives, as it provides a sense of meaning, purpose, social belonging and economic support. This dimension of life can exert both positive and negative effects on workers' health. On the one hand, work may promote feelings of contribution, identity, and engagement by enabling individuals to participate in activities perceived as meaningful and important. On the other hand, adverse working conditions and events (such as an occupational accident - OA), can pose significant risks to workers' physical and psychological health.

Occupational accidents can be defined as a "discrete occurrence in the course of work which leads to physical or mental harm" [1]. This definition comprises the fact that they are unforeseen events that occur while workers are performing their occupational activities, during working hours, or while commuting to and from work. They are unexpected, distressful, and potentially traumatic events, that may result in temporary or permanent, physical and/or psychological outcomes of varying degrees of severity, thereby affecting work capacity [2-4]. In fact, after a non-fatal OA, workers often require treatment and periods of work absence to recover before return to work, even in minor situations.

Despite all efforts that have been made regarding health and safety at work, OA remain a public health, social, and economic challenge [5, 6], and continue to represent a significant cause of premature death, morbidity, and disability for many workers around the world [7, 8]. The impacts of OA injuries and their temporary and/or permanent outcomes are felt not only at macro level, such as economic and public health resources, but also at personal/micro level with important changes occurring in workers' personal, familiar, social, financial, and professional lives [2, 3, 7]. Therefore, they may lead not only to productivity decline, but also to increased needs of health services assistance throughout lifespan, work absenteeism, and physical and psychological short or long-lasting problems.

Given OA wide impacts it is of utmost importance that injured workers are medically assisted and treated to regain their maximum functionality in all life dimensions, including socio-professional. In fact, socio-professional rehabilitation and reintegration

is an essential dimension of the recovery process, since being active provides, for injured workers, not only a context for physical and intellectual activity and for social interactions, but also allows them financial stability and a sense of belonging and purpose that is fundamental for emotional stability [9-12].

Frequently, for these injured workers, return to work is a path full of difficulties and challenges, especially in more severe cases in which work capacity and functionality is often more compromised. Many countries, where Portugal is included, have established a system for personal injury assessment (PIA) and reparation after OA, which may include treatments, job adaptations or reconversion, professional and vocational training and even the attribution of financial compensation when earning capacity is affected.

Knowledge about what dimensions can affect, positively and/or negatively, professional and social reintegration, after an OA is very important since it can assist in providing injured workers more efficient assessment and rehabilitation treatment options aimed at promoting successful socio-professional reintegration, in cases when remain work capacity allows it, and a proper and faster reparation when permanent damages require it.

1.1. Epidemiology

Epidemiological data on OA is of extreme importance to: (a) foster injuries prevention; (b) provide information about the affected population; (c) allow to understand most common injuries and permanent sequelae; (d) shed light on recovery, rehabilitation, and return to work processes.

The *European Agency for Safety and Health at Work* identifies five types of costs related to OA: (a) productivity costs, those directly related to the loss of productivity due to absenteeism; (b) health costs, including all medical expenses related to treatment both direct (e.g., surgeries, medications, etc.) or indirect (e.g., the need for professional care); (c) economic costs derived from the loss of the employee's functionality and quality of life; (d) administration costs related to the event or illness, such as applying for payments to insurance companies and social security; (e) costs related to workers' reparation insurance, such as indemnities or pension payments [13]. The personal costs were left out of this systematization, probably because they are difficult or impossible to measure.

It is undeniable that mortality and morbidity related to OA affects not only the workers and their families, with impacts on several life domains (personal, social, financial, familiar, and professional), but also represents a high cost for society. Global data on occupational injuries, and their financial and social burden, is hard to obtain not only because of the different systems of data recording around the world, but also due to the absence of records in several countries. The existent data will be described below.

1.1.1. World and European figures

The first studies on worldwide statistics regarding OA and work-related diseases were published back in 1999 by Takala [14], who estimated a total of 335 million occupational injuries (fatal and non-fatal, including commuting accidents and occupational diseases). Leigh and colleagues [15] followed with an estimated annual incidence of 100 000 000 occupational injuries (100 000 deaths) and 11 000 000 occupational diseases (700 000 deaths). Both authors considered that their results were conservative estimations, due to unavailability of data for all countries, underreporting, limited coverage by reporting and compensation schemes, and non-harmonized accident recording and notification systems.

The joint work of *World Health Organization* (WHO) and *International Labour Organization* (ILO), reporting to data from 2000-2016, estimated that worldwide nearly 1.9 million deaths were attributable to work-related injuries and diseases, highlighting the magnitude of the work-related premature mortality worldwide [16].

More recent data for ILO (2023) reveal that , each year, occupational-related injuries and diseases account for approximately 2.93 million deaths worldwide, reflecting a substantial burden associated with occupational risks [17, 18]. Of these fatalities, around 330 000 deaths are attributed specifically to OA, while the remaining deaths are linked to work-related diseases [17, 19]. In addition to fatal outcomes, the ILO estimates that each year approximately 395 million workers worldwide sustain non-fatal occupational injuries, pointing out the extensive scale of work-related harm beyond mortality [18, 19]. These injuries contribute substantially to lost workdays, disability, and health care demands, representing a yearly economic burden of approximately 4% of the global gross domestic product, besides the unmeasurable human costs [6, 20-24]. The report underlines that more men die from work-related incidents (51.4 per 100 000 working age adults) than women (17.2 per 100 000).

Manufacturing, construction, wholesale and trade, health and social work, agriculture and transport and storage are the sectors, where more non-fatal OA occur [25].

In European Union (EU-27), approximately 2.82 million non-fatal OA, resulting in at least four days of absence from work, were recorded in 2023, representing a slight decrease of approximately 5 % when compared with the previous year [26, 27]. During the same year, 3 298 fatal OA were recorded, corresponding to an incidence rate of 1.63 fatal accidents per 100 000 employed persons [26, 27]. These figures indicate that, while fatal OA are relatively rare in the EU-27, non-fatal injuries remain highly prevalent, with the ratio of non-fatal vs fatal accidents exceeding 850 to 1. The total cost of OA and illness in EU-27 was estimated at 476 billion euros, which represents 3.3% of its gross domestic product [21]; non-fatal OA cost represent 56.4% of this total. Professional sector-specific analyses consistently identifies manufacturing, construction, distributive trades, and human health and social work activities as those with a high number of reported OA [28]. This distribution reflects both the world size of the workforce in these sectors and their inherent exposure to physical, mechanical, and organizational hazards.

Taken together, World and EU-27 statistics demonstrate that OA remain a widespread and significant problem, affecting hundreds of millions of workers and resulting in substantial mortality and morbidity. While EU-27 exhibits lower fatality rates than global averages, the high incidence of non-fatal accidents highlights the ongoing need for preventive strategies, and of treatment and rehabilitation policies and services aimed at minimizing the impacts of injuries on workers functionality and work capacity.

1.1.2. Portuguese figures

In 2023, Portugal recorded a total of 184 607 OA [29]. Of these, 136 accidents were fatal, representing a 3.5% decrease in comparison with the previous year (141 deaths) [29, 30]. The vast majority (99.9%) of the events were non-fatal [29, 30].

The huge impact of these events is shown by trends in work absence, since days lost due to OA are key indicators of severity and cost. The total number of working days lost, in 2023, due to OA increased by 5.1% when compared with previous year, and was in average of 38.6 days per accident [29]. These data suggest that although the overall number of OA has remained relatively stable in the last years, the severity of non-fatal injuries might be increasing.

Portugal has historically exhibited high incidence rates of OA than other EU-27 countries. In 2023, Portuguese incidence rates of non-fatal accidents reached 2 956 non-fatal injuries per 100 000 employed persons, a rate that, alongside with France and Spain, is among the highest rates in the EU-27, [28]. Furthermore, Eurostat data confirms that the Portuguese incidence of workplace injuries and non-fatal events remains substantially higher than in several other EU-27 members [27]. Most non-fatal events involved workers aged 35–54 years, while fatal accidents were more frequent among those aged 45–64 years [29]. Construction sector accounted for about 30 % of all OA, followed by manufacturing (23%), with men sustaining more occupational injuries [28-30]. Regarding injuries the most common pattern were superficial wounds affecting upper extremities [29, 30].

Although no official Portuguese government source currently provides an accurate estimation of OA costs, studies conducted in selected EU-27 members demonstrate that the societal costs of occupational injuries and diseases typically represent between 2.7%-5% of countries gross domestic product [23], a number that evidences the economic impact of OA.

1.2. Occupational accidents in Portugal: the present risks and needs for socio-professional reintegration

OA remain a significant determinant of professional incapacity and long-term disability among the working population in Portugal. Although Portuguese statistics indicate that the incidence of events is becoming relatively stable, the rise in work absence days suggests that the severity of non-fatal injuries (and their impact on workers' functional capacity and employability) has increased, raising concerns about prolonged incapacity, delayed return to work, and increased risk of permanent disability [29].

As stated above, Portugal consistently reports higher rates of workplace injuries than several other EU-27 Member States. Given that non-fatal OA are the principal pathway to temporary incapacity and permanent professional disability, this elevated incidence rates translate into a substantial population at risk of long-term functional impairment and socio-professional exclusion.

Demographic and sectoral analyses indicate that men are disproportionately affected by occupational accidents, particularly in high-risk sectors such as construction and manufacturing, where physical demands and exposure to hazardous conditions are

higher [29, 30]. These sectors are also associated with higher probabilities of severe musculoskeletal injuries, and polytrauma, which are common precursors of both prolonged work incapacity and, in some cases, permanent professional disability (PD). Non-fatal accident rates remain persistently high, sustaining a steady inflow of workers requiring medical rehabilitation, work adaptation, or formal personal injury assessment (PIA) [28, 31]. This epidemiological pattern highlights a critical shift in the occupational health burden - from fatal outcomes toward chronic consequences of injury, including reduced work capacity (due to PD), and short- and/or long-term dependence on insurance reparation and social protection mechanisms.

Taken together, these findings underscore that in Portugal OA are not only a matter of injury incidence but also a major driver of professional disability, with significant implications for workers' physical and psychological well-being, quality of life, professional and social participation, and for social security systems. The challenge seems to require joint, structured, and integrated services, provided by multidisciplinary teams where injured workers, insurance companies, labour courts, professional rehabilitation centers, occupational medicine, and employers combine efforts to ensure the worker's recovery and socio-professional reintegration.

2. Physical and psychological consequences after an occupational accident

OA are unexpected and acute traumatic events, that may lead to temporary or permanent impairments of workers' physical and/or psychological capacities and therefore are a potential source of health distress [2-4].

While the repercussions of permanent physical sequelae on socio-professional reintegration are well established [32] and easier to proven objectively, temporary or permanent psychological outcomes may be equally disabling, with profound consequences for functional recovery and return to work, and more difficult to identify and proven [9, 33, 34]. Extensive evidence demonstrates that psychological symptoms among injured workers are highly prevalent, persistent, and have a significant influence on long-term recovery and rehabilitation outcomes [9, 33-38].

Following an OA, injured workers may experience a range of psychological symptoms, including: (a) asthenia and adynamia related to inactivity; (b) feelings of extreme vulnerability; (c) emotional distress; (d) pain and instability; (e) symptoms of anxiety,

depression, or fear regarding the future; (f) sleep disturbances; (g) somatic complaints; (h) behavioural disturbances; (i) subclinical or clinical post-traumatic stress disorder [35, 39, 40]. Furthermore, this traumatic and stressful experience may trigger maladaptive cognitive and emotional processes, leading to phenomena such as rumination, catastrophizing, fear-avoidance, altered perceptions of personal abilities, reduced sense of control, and cognitive distortions, all of which are associated with poorer mental health [10, 41-46].

Temporary or long-lasting, psychological symptoms impact extends deeply into injured workers functionality, affecting their autonomy, family relationships, social participation, and perceived health status [39, 47-50]. Emotional suffering has been associated with reduced self-perceived health, impaired social functioning, and difficulties in adapting to injuries outcomes [48, 50, 51]. Injured workers often face complex challenges during rehabilitation and socio-professional reintegration process, including stigma, fear of re-injury, altered professional identity, and difficulties negotiating work accommodations [44, 46, 47], challenges that can be exacerbated within insurance reparation and medico-legal contexts, where system-related factors can contribute to psychological distress [52, 53]. But we should also remind that economic aspect can have a negative effect on injured workers involvement on the required recovery and rehabilitation process efforts due to expectation of increased gains from the OA [46, 52-55]. Financial reparation after OA is directly indexed to PD rate, and therefore, injured workers, which often have low information regarding reparation system and often collected from information thrived by peers, may believe that early return to work may signify a decrease on their PD rate. As a result, they can exaggerate or simulate symptoms and its severity, refer symptoms that are no longer present, and/or be unwilling to collaborate during the process. Even so, this should not be a reason to not be aware to these symptoms and properly assess them.

The impact is not confined to the injured worker alone; families often experience emotional, financial, and relational strain because of prolonged disability and uncertainty regarding their familiar recovery and future socio-professional reintegration [39, 50], affecting their psychological stability.

For some injured workers these symptoms may not appear or may be mild and temporary and disappear over time without the need for specialized help, but for others they can be more severe and persistent, requiring treatment to prevent or reduce permanent mental health disorders [9, 33, 34, 41-43, 45, 56, 57]. Long-term follow-up

studies have shown that psychological outcomes can persist several years after the OA, significantly affecting recovery, reintegration and the overall injured workers quality of life [9, 33, 56]. In fact, if psychological disorders are not properly assessed and treated, they can have profound impacts on workers' well-being and their work capacity, which compromises professional reintegration (PR) outcomes and increases the odds of a PD [7, 9, 34, 36, 58-61].

Being alert to psychological consequences of an OA (either there is a direct result of trauma or arise as secondary result), screening them as early as possible, and if needed offer properly treatment aimed at help coping and adjusting to the situation, is essential to reduce the probability of these psychological disorders to become permanent. Even if to do so in scope of a personal injury repair system, in which eventual financial reparation is at stake, is a complex task, its importance is undeniable, namely in establishing a link between permanent sequelae and professional reintegration difficulties. For this, the contact between insurance physicians, employers and occupational physician of the worker company is of utmost relevance. However, this is not yet common in Portugal, due to a lot of difficulties in that articulation, especially in the case of small or median-sized enterprises. This may be one of the reasons why some psychological outcomes are frequently not recognized as occupational-related. As a result many injured workers in psychological suffering, may not receive the proper assessment, monitorization and treatment at an early stage, being later attended by other health services rather than from damage repair systems [35, 62], and at a stage where psychological symptoms are chronic and exacerbated.

3. Personal injury assessment in the scope of the Portuguese labour law

The protection of workers' physical and psychological integrity constitutes a fundamental pillar of Portuguese labour law (Law No. 98/2009, september 4th). Under this Law, "an occupational accident is one that occurs at the workplace and during working time and that directly or indirectly causes bodily injury, functional disturbance or disease, resulting in a reduction of work capacity or earning capacity, or death" (Law No. 98/2009, September 4th, Article 8).

OA are events of extreme legal, social and economic relevance, since they produce a direct effect on workers' physical and psychological functioning, professional abilities,

and quality of life, while simultaneously also impacting employers, and insurance and social protection systems.

3.1. Portuguese Labour Law

Portuguese labour legal regime on OA is primarily established by Law No. 98/2009, September 4th, which regulates the assessment and reparation system. This law sets out the rights and obligations of workers, employers, and insurance companies. OA insurance is mandatory for employers, so that treatment, rehabilitation, first PIA (when necessary), and damage reparation liability is transferred to insurance companies, that assume responsibility for the accident (if causality nexus is admitted).

After an OA the worker is therefore treated at the insurance companies' clinical services, and when the assisting clinicians consider that the treatment and professional rehabilitation process has been accomplished, they require a PIA, that is performed by a medical expert from the insurance company (this process will be detailed in next section). The resulting report informs about medico-legal permanent professional damages and is sent to the Public Prosecutor's Office of the respective labour court, whenever a permanent professional disability (PD) is assigned. The subsequent process depends on parties funding an agreement or not. If they do agree reparation is concretized, if they don't the process goes to the *National Institute of Legal Medicine and Forensic Sciences* (NILMFS) where another PIA is conducted on injured worker. If even after that parties' agreement is still not achieved the process goes to a labour court trial. Detailed description of this process is presented at Figure 3, of page 62 (Results section) [63].

According to Law No. 98/2009, September 4th, all OA victims have the right to be followed throughout their lifespan by the responsible insurance company services for every need's adjustment (e.g., medical appointments, ancillary exams, medicines, treatments, technical aids, third party assistance). The same Law also defines that, when necessary, a PIA revision can be made once a year (Article 70^o), which means that PIA can occur throughout the victims' lives in a follow-up process, whenever is justified and particularly in major injury cases.

The professional rehabilitation and reintegration effort should receive properly attention from the employer (with the support of Occupational Health Medicine services), so that the professional tasks and working conditions attributed to injured

workers are compatible with their current functional status (in accordance with Article 44 and paragraph 1 of Article 155, both of the Labour Law).

Injured workers have the fundamental right of their physical and psychological integrity, which means that when personal damage occurs they are entitled to have a corresponding reparation for that damage. This system is based on the principle of objective liability and is dependent on the existence of a causal link between the OA and the personal injury suffered by the worker. Both insurances and employer responsibilities and the types of damage to be repaired are also defined in the legislation. These damages include physical or psychological harm, such as bodily injury, physical and psychological impairment, or death, as well as labour-related consequences, namely the impact of the accident on the worker's capacity to perform work or earn income. In OA cases reparation primarily addresses patrimonial (economic) damages (including loss of earnings, economic lost due to temporary or permanent incapacity, medical and rehabilitation costs, funeral expenses, and disability pensions, among others), which can be provided in kind or in monetary form. The law also emphasizes the injured worker right to be assisted at rehabilitation and professional reintegration, obliging employers to ensure reintegration and, if needed, workplace and professional tasks adaptation.

3.2. Personal Injury Assessment: purpose and methodology

Portugal has standardized rules for PIA published by the NILMFS [64, 65], which are followed by both the public and private sectors (including most insurance companies). The methodology used varies according to damage's aetiology and the area of law-related requests (labour, civil, or criminal) [65-68].

PIA aims to describe the OA temporary and permanent outcomes, quantifying damage parameters. For that purpose, it is important to maintain present that the object of assessment is the whole person, and so all personal damage needs to be evaluated using a biopsychosocial and ecological approach [66, 69].

In OA cases a PIA is required when the insurance clinician considers that professional rehabilitation is conclude, which can mean full recovery or remaining disability. The evaluation is conducted by a medical expert of the respective insurance companie, that produces a report, that includes description of the event, injuries and their evolution, treatments administered, ancillary examinations, previous medical history, current

complaints and results of physical examination. Furthermore, it establish the medico-legal link between trauma mechanism, injuries, and sequelae, identifies the cure or consolation date, and defines the temporary and permanent professional damage parameters (including the victim's needs) [64-66, 70-72].

The comprehensive description of personal damages is grounded in the three-dimensional methodology (3-DM) [66, 69]. Based on an ecological and biopsychosocial model, the 3-DM offers a systematic and validated method to describe trauma outcomes. It considers three levels of damage, and the associations between them [66, 69]: (a) the *body level*, which assesses biological outcomes with their morphological, anatomical, histological, physiological and genetic particularities; (b) the *capacities level (functions)*, which assesses physical and mental capacities (current or potential), taking into consideration the person's age and sex irrespective of the his/her setting of life; (c) the *life situations level (participation and activities)*, which assesses the confrontation (concrete or potential) between the victim and the reality of his or her physical, familial, social, cultural, educational and professional environment. 3-DM also allows the assessment of Damage Coefficient - average of the final scores obtained for the severity of body structures, functions, and life situations -, a way to quantify objectively global damage severity [69, 73].

Portuguese reparation system main objective is to provide the injured worker with the services, resources and support necessary to allow him/her a dignified life, with the maximum of autonomy possible, and improve his/her overall quality of life. It is grounded in the principle of legally defined full reparation, within the limits established by statute. Reparation includes kind and/or financial benefits. Benefits in kind comprise, among others, medical, surgical, pharmaceutical, hospital, and rehabilitation care, as well as future therapeutic support, assistive devices, home or car adaptations, or third-party assistance. Financial benefits are intended to repair permanent loss of work and/or earning capacity, and take the form of indemnities or pensions, which may be temporary or lifelong, depending on the degree and nature of PD.

3.3. Medico-legal damage parameters in Labour Law

In Portugal medico-legal damage parameters differ accordingly to the applicable legal framework [66]. Portuguese system distinguishes between temporary incapacity and PD.

3.3.1. Temporary damages

Temporary damages (occurring between the OA injuries' date, and the date of cure or consolidation) that the clinician can attribute are [65, 66, 69]:

- a) *Temporary Total Professional Disability (TTPD)*: corresponds to the period, measured in days, in which the injured worker is totally unable to perform his/her professional activity;
- b) *Temporary Partial Professional Disability (TPPD)*: period (in days), during which the injured worker is regaining the capacity to perform his/her professional activity, but still with limitations, converted into a percentage rate of temporary incapacity.

3.3.2. Permanent damages

Permanent damages (those that remain after medico-legal consolidation date is defined), can be classified as partial or total (this last, for the regular professional activity or for all kind of work). The determination of the type and degree of PD, by a medical expert, is a decisive stage in the reparation process, as it directly influences the amount and form of benefits awarded. PD assessment is conducted according to medico-legal criteria, considering the *National Permanent Disability Table* (Annex 1 of the Decree-Law No. 352/2007, October 23rd), which serves as a normative and technical instrument designed to ensure consistency, objectivity, and equity in the evaluation of PD in OA cases. Permanent damages are [65, 66, 69]:

- a) *Partial Permanent Disability (PD)*: it is assigned in a percentage, when injured worker is considered capable of maintaining his/her usual work or other similar work in his/her technical-professional qualification/competence. This, despite the work may require increased efforts, some eventual workplace adaptation or even the use of technical aids. In these cases, a loss of gain capacity is assumed;
- b) *Permanent Absolute Disability for Regular Work (PAD-RW)*: is assigned, together with PD, when it's considered that the worker is unable to maintain

his/her regular work or other in the area of his/her technical-professional qualification/competence, being a professional reconversion possible, considering the victim's sequelae, remaining capacity, qualifications and age, among others [74];

- c) *Permanent Absolute Disability for Any Work (PAD-AW)*: is assigned, together with PD (in general almost 100% of PD), when the victim is considered completely unable to perform any type of work.

4. Professional reintegration and HRQoL after an occupational accident

Professional reintegration (PR) following an OA is of utmost importance, constituting a milestone for restoring a sense of competence and normality in victims and their family's life [9-11, 75]. PR refers to workers reintegration in the exercise of a profession (the same as the previous one, or another). Nevertheless, it remains a major challenge.

According to Portuguese labour legislation, in OA cases employers have the obligation to ensure that the worker who has suffered an accident at his/her service is reintegrated in occupational functions that are compatible with the functional limitations that have result from the event (Law No. 98/2009, September 4th, Article 155^o, No.1).

The notion of remaining capacity and the importance of addressing this aspect in medico-legal terms, considering the rehabilitation and reintegration possibilities, is implicit here [76]. In some cases, the workers may need to undergo a *professional reconversion*, which corresponds to the worker requalification and reintegration in an activity that requires a different technical-professional qualification/competence from his/her previous one, taking into account the remaining capacity, school and professional qualifications, age, as well as possible needs in terms of adapting to the new job, technical aids and professional training [74].

Professional reintegration/ reconversion after OA is a complex process, with several internal and external dimensions interfering, both positively and negatively. But is undoubtable that professional reintegration/reconversion is tremendously important not only for improving injured workers quality of life, well-being, social participations, sense of utility, physical and cognitive capacity, but also at social and financial levels in order to reduce costs related to work absence and medical care of secondary impacts

of OA, and to reduce financial dependence. In fact, we can consider being professionally active as a protective factor of both physical and psychological health [9-12].

Being social and professionally integrated is extremely important for recovery and perceived health status, preventing the emergence of psychological problems, such as depression. Therefore, it is a major contribution to improving physical functioning, self-confidence, economic status and increasing sense of utility, social participation, quality of life, and well-being [9-11]. On the opposite work absence, especially if prolonged, and the late start of PR process can lead to increased morbidity and health comorbidities, including psychological problems (e.g., depression and anxiety), reduce functional independence and social isolation, as well as tremendous effects on the ability to perform professionally and, consequently, prompting financial problems [12, 61]. All these factors can, and often do, increase the costs of workers' legal reparation [72, 77].

It should be noted that the process of labour rehabilitation contributes to reduce the extent of physical and psychological sequelae. Indeed, this step of partial return to work proves to be essential not only for promoting a better and faster PR, whenever possible, but also for the overall health of the examined individual, as is well demonstrated by recent scientific evidence [9, 40, 78-81]. In fact, functional limitations and post-traumatic psychological symptoms improve with active life, and failure to encourage return to work (due to inactivity and excessive self-focus) inhibits the natural process of recovery and stabilization of sequelae, and may even worsen certain clinical conditions [82].

As so, early PR in the same occupation or in another adjusted to victims' current functionality is fundamental because it provides (a) context in which coping skills to deal with disabilities can be learned and trained [47, 77]; (b) physical conditioning and functionality improvements [47, 77]; (c) a sense of self-efficacy recapture, allowing the victim to recover self-confidence in his/her abilities and capacities, helping the maintenance of professional activity in the long term [47, 61, 83]; (d) a sense of utility and identity associated with respect and social recognition, increasing social support and contacts, which are extremely important at reducing the risk of depressive and anxious symptoms [75, 84]; (e) improved quality of life [47, 77].

Research on return to work after OA identifies distinct reintegration trajectories and a set of interacting facilitators and barriers. Baril et al. [85] described four main

outcomes: return to the same employer, change of employer, non-reintegration, and unemployability. This model was later refined by Durand et al. [86] who distinguished trajectories based on employment status and the presence of obstacles during rehabilitation. The authors identified as facilitators of successful reintegration early and coordinated medical management, strong adherence to rehabilitation, employer support, flexible work arrangements, workplace adaptations, and a collaborative organisational environment. In contrast, prolonged absenteeism, poor pain management, fear of reinjury, negative self-perception, workplace stigma, administrative and legal obstacles, and lack of employer engagement are consistently identified as barriers to return to work [86-88]. Overall, these studies support a multidimensional framework for PR, in which clinical, personal, organisational, and systemic factors jointly shape post-accident work outcomes. Following all this it is important to state that successful socio-professional reintegration is dependent of a complex interaction of personal, work context-related, and reparation system-related factors. Common factors that have been associated with poor PR outcomes are [9, 36, 49, 60, 61, 89]: (a) being older; (b) being female; (c) experiencing previous sick leave and unemployment; (d) having high levels of pain and disability; (e) having depression; (f) having anxiety; (g) having high physical work demands; (h) experiencing perceived limitations in performing daily life and professional activities. However, higher education and socioeconomic status, higher self-efficacy and optimistic expectations about recovery and return to work, low injury severity, coordination of the professional reintegration process, and multidisciplinary interventions that include the workplace and stakeholders were found to be factors associated with good outcomes in terms of PR [9, 36, 49, 60, 61, 89]. Thus, employers and workplace conditions have an important role on PR. The early engagement of employers in professional rehabilitation and reintegration, along with perceived workplace peer support, accommodations, and flexibility in adjusting job responsibilities and schedules to accommodate individuals' functionality resulting from OA, produces a sense of psychological safety and security in injured workers that has been established as a good predictors of successful PR [32, 53, 54, 59, 77, 83].

Efforts at minimizing prolonged work absence and promoting early and adjusted reintegration require the participation of several professionals of insurance medicine (e.g., medical assistance providers, rehabilitation, psychological and social worker professionals) and occupational medicine, employers, and victims and their families

[90]. The early engagement of these multidisciplinary teams has been evidenced as an important predictor of good professional outcome and therefore must be reinforced [32, 53, 54, 59, 83], with victims referred to specialized services having better odds of successful PR.

Injured workers health-related quality of life (HRQoL) may be significantly affected by the considerable negative consequences that OA events can have at several domains (physical, psychological, social, financial, familiar and professional) of injured workers' life. HRQoL is multidimensional concept, that reflects the individual's perceived physical and mental functioning across multiple domains and is a critical outcome measure following injury [91].

Evidence demonstrates that injured workers experience significant reductions in their HRQoL, when compared with non-injured, even many years after the event [92, 93]. Pain, functional limitations, psychological symptoms (anxiety/depression) and disruption of personal and professional identity are common consequences of occupational injuries that affect HRQoL [94, 95]. Studies have evidenced that HRQoL may remain compromised years after injuries have occurred [96].

HRQoL is closely tied to PR, where those who fully return to work typically exhibiting higher HRQoL scores than those who have partially returned or remain professionally inactive [97]. Conversely, persistent deficits in HRQoL (reflecting limitations in physical functioning, social participation, and mental health) are associated with slower or incomplete return to work highlighting the extent to which quality of life impacts professional outcomes [98].

These findings underscore the multidimensional challenges that occupational injured workers suffer, and that reflects on their overall HRQoL. Standardized assessment of HRQoL may be of assistance on understanding the interplay between physical, psychological, and social factors that lead to successful socio-professional reintegration, guiding on the design of interventions aimed at optimizing PR trajectories.

II. OBJECTIVES OF THE GLOBAL STUDY

1. Previous considerations

Given the incidence and short and long-term consequences that OA produce on injured workers several live dimensions, especially on socio-professional integration, coordinated and multidimensional assessment and interventions during recovery, rehabilitation and reintegration processes are needed to guarantee that injured workers return to work as soon as possible, whenever their remain functionality allows it. In fact, it has been shown that early return to work is of utmost importance for recovery processes since it helps increase perceived health status and capacity, functioning as a protector against long-term disability [9, 10, 99, 100].

Nevertheless, doing so is a complex task that must be grounded on evidence-based knowledge about the factors that are related with successful return to work processes, even when professional disability remains. In Portuguese context services are primarily provided by insurance companies, and after those different services, depending on the cases (professional and vocational rehabilitation centers, health care system, employment services, NILMFS, labour court) may be called into the process. The need of a common understanding about what fosters successful pathways of return to work is still needed.

Therefore, all contributions that can support the knowledge about what dimensions are affected in short and long-term, how they affect workers functionality, and how that interacts with professional reintegration and work capacity, are not only necessary but fundamental to assist on policies and services development.

2. General main objective

The general aim of this research is to provide evidence on the variables that influence socio-professional reintegration after OA, to support recovery, rehabilitation and reintegration services and professionals in developing assessments and interventions designed to achieve more successful professional reintegration outcomes.

3. General specific objectives

To address the main objective of the present research, a set of tasks was defined, corresponding to three original studies. These studies are logically articulate to enable a better understanding of the phenomenon under analysis, and they pursue the following objectives, respectively:

- a) To reflect on the role that legal medicine, concretely personal injury assessment can play in promoting the professional integration of major occupational accidents victims, through the analysis of the factors associated with professional reintegration in OA severe cases;
- b) To analyse the relationship between psychological symptoms at the end of the occupational accident recovery and rehabilitation process, and two main outcomes: professional reintegration and permanent professional disability;
- c) To analyse the effect of personal variables, occupational injury severity, permanent professional disability, and professional reintegration on injured workers' health-related quality of life perception.

III. GENERAL MATERIAL AND METHODS

The present research was approved by the Ethics Committee of the Faculty of Medicine of Porto University – Centro Hospitalar de São João (Appendix B), and was conducted in accordance with the Declaration of Helsinki.

All participants were recruited from a Healthcare Unit of a Portuguese insurance company and gave their informed consent (Appendix C). A detailed description of the material and methods used in each study is described in the corresponding papers (Results section). Here, we will just provide a general overview of material and methods subjects.

Study 1: The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution

This retrospective study used a convenience sample of 103 severe OA cases. Data were collected from insurance company PIA reports regarding: (a) permanent professional damage parameters evaluation homologated by a labour court (in average 4.8 years after the accident); (b) PIA follow-up and personal needs adjustments (in average 18.9 years after the accident).

Clinical records were used to retrospectively estimate injury severity (IS) in the acute phase.

The *Inventory for Handicap Assessment (IHA)*, for the *Three-dimensional methodology*, was used to describe and quantify injured workers severity degrees of *body*, *functional* and *situational* permanent outcomes, and of *Damage Coefficient (DC)*. Permanent professional damage parameters - type and rate, permanent needs, and current professional status (unemployment, early retirement, professional reconversion) were also collected from PIA reports.

Data analysis was used to: (a) describe injured workers sociodemographics, trauma characteristics, including acute injury severity, and permanent outcomes and needs; (b) *chi-square test* and *Spearman* correlations to assess the relation between age, sex, ISS, IHA dimensions severity, DC, professional status outcomes and the medico-legal permanent professional damage parameters homologated at a labour court; (c) *chi-square test* and *Spearman* to assess the dependence between age, sex, ISS, IHA dimensions severity, DC and the professional status outcomes.

Study 2. Relationship between psychological symptoms and professional reintegration after an occupational accident: a Portuguese cross-sectional forensic study

A prospective and cross-sectional study, using a convenience sample of injured workers ($n=101$) at the end OA recovery and rehabilitation process (final PIA), was conducted. Data were collected over a 6-month period.

After providing written informed consent, participants underwent a semi-structured interview, where capacity to participate was assessed and sociodemographic information gathered.

Injury severity was estimated through permanent professional disability (PD) rates assigned at final PIA, using the following categories: 0%: non-existent; 1%-5%: minor; 6%-15%: moderate; 16%-40%: serious; 41%-70%: severe; >70%: critical.

Psychological symptoms through self-report measures: (a) emotional pain - a subjective self-reported measure was used, and participants were asked to rate their current perceived level of emotional pain, and suffering related to the experience of OA and its outcomes; (b) *Work and Social Adjustment Scale* (WSAS) - a measure of injured workers perceived impact of their mental health of ability to function in several life domains; (c) *Generalized Anxiety Disorder questionnaire* (GAD-7) - screening tool and severity measure of anxiety symptoms; (d) *Patient Health Questionnaire* (PHQ-9) - screening tool and severity measure of depression symptoms.

Statistical analyses were conducted: (a) descriptive to characterize participants' demographics, accident mechanisms, injury location and severity, current professional status, PD type and rate, and psychological symptoms (emotional pain, WSA, anxiety, and depression levels); (b) *Chi-square* and *Spearman* to analyse correlations between psychological symptoms, age, sex, education, marital status, injury severity, and both PD and professional status; (c) *independent sample t-test* to analyse potential differences in psychological symptomatology between professionally active and inactive participants; (d) *independent sample t-test* to evaluate potential differences in psychological symptomatology between those who were assigned a PD and those who weren't.

Study 3. Quality of life post-occupational accident. A reintegration and forensic approach

This study was conducted with the same design and population used on study 2.

Sociodemographic information (sex, age at the time of the accident, marital status, and profession) was collected during a semi-structured interview: (a) female vs male; (b) <50 years vs ≥ 50 years; (c) living in communion vs living alone.

Participants also responded to following self-administrated questionnaires: (a) *Resilience scale for adults* (RSA) - to assess participants resilience level; (b) *36-Item short form survey* (SF-36) - to assess injured worker health related quality of life (HRQoL).

For this study acute injury severity (IS) was estimated based on medical reports and for analysis two groups of IS were defined: none-moderate vs serious-critical.

Permanent professional disability (PD) rate, and professional reintegration (PR) information was obtained from PIA report, and two groups were defined for each variable, respectively: (a) none-minor vs moderate-severe; (b) reintegrated vs non-reintegrated.

Data analyses allowed to: (a) describe sample including personal variables, IS, PD, PR, and HRQoL scores; (b) compare injured workers' HRQoL with the Portuguese norms through *independent-sample t-test*; (c) explore relationships between HRQoL and sex, age, marital status, resilience, IS, PD and PR through *Spearman* or *Pearson correlations*; (d) compare HRQoL scores between the groups created for each variable (described above), using *independent-samples t-test* or *Mann-Whitney U*.

IV. RESULTS

This section presents the papers written in each of the three studies. The papers were re-formatted according to this document's style, and each paper's references were re-indexed and presented in the global references, Chapter VII – page 115.

1. The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution

The work described in this Chapter was published in The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution – Journal of Forensic and Legal Medicine, authored by Isabel Almeida^{1,2}, José Manuel Teixeira³, Teresa Magalhães^{1,3,4}. <https://doi.org/10.1016/j.jflm.2022.102391>

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Abstract:

Occupational injuries represent an enormous economic impact for victims, respective families, involved institutions and all the community due to professional outcomes. Thus, it is of the utmost importance that medico-legal personal injury assessment and the posterior follow-up of these victims, may allow their concrete damage repair, considering the victims' needs fulfilment and professional reintegration, whenever possible. The main objective of this study is to reflect on the role that legal medicine can play in promoting the professional reintegration of victims of major occupational accidents through the analysis of occupational injuries cases considering the medico-legal examinations performed. A retrospective study was conducted using medico-legal major occupational injuries cases (*Partial Permanent Disability* $\geq 40\%$). Data were collected from two medico-legal assessment moments: (a) personal injury assessment homologated by a labour court 4.8 years on average after occupational injury; (b) medico-legal follow-up for needs and/or *Partial Permanent Disability* adjustments performed 18.9 years on average after occupational injury. The final sample includes 103 cases. The results showed that in major occupational accidents, permanent long-term outcomes were principally associated with neurological (62.1%) and orthopaedic

(52.4%) sequelae. Permanent professional damage parameters assigned by the labour court included *Partial Permanent Disability* (23.3%), *Permanent Absolute Disability for Regular Work* (41.7%) and *Permanent Absolute Disability for Any Work* (35%). Three-dimensional methodology is helpful in predicting *Partial Permanent Disability* and *Permanent Absolute Disability for Any Work*. However, three-dimensional methodology did not reveal correlations with *Permanent Absolute Disability for Regular Work*, and currently 65% of the victims who were considered able to work by the labour court are not professionally active. Thus, these major cases deserve a more detailed medico-legal approach based on concrete information about the professional reality of each victim, especially cases with an eventual *Permanent Absolute Disability for Regular Work*. Medico-legal Injury Assessment must be based on concrete aspects of the victim's professional reality and not only on permanent disability tables. This calls for an articulation between all institutions working with the victim of occupational injuries and legal medicine to promote recovery and the necessary measures to assure professional rehabilitation.

Keywords: Occupational injury; Professional outcomes; Professional reintegration; Injury assessment; Legal medicine

Introduction

Injuries due to occupational accidents constitute a public health, social and economic issue [5, 6]. They are one of the leading causes of premature death, morbidity, and disability in a significant number of persons [7, 8].

The type and severity of occupational injuries (OI) have been identified as important predictors of trauma outcome [101, 102]. Its impact can be felt at all life dimensions with victims experiencing short- and long-term health consequences that decrease the quality of their life and of their families [3, 8].

Each year, a total of 374 million nonfatal occupational accidents are estimated to occur worldwide, and the loss of workdays globally represent approximately 4% of the world's gross domestic product [22-24].

In 2019, Portugal registered a total of 10.8667 occupational accidents that were fatal in 122 cases. The incidence rate of nonfatal accidents was 1.055,4/100000 workers with temporary consequences requiring work absence in 79.376 cases (73.1%) [103, 104].

Consequences are frequently long lasting and cross cutting several domains of physical and emotional functionality with familial, social, professional, and economical repercussions. Victims frequently report some of the following outcomes [9, 99, 101, 105, 106]: (a) high levels of physical changes and pain; (b) high emotional suffering and increased anxiety and depression; (c) reduced capacity to perform daily life activities; (d) increased rates of work absence and unemployment or even of early retirement with decline of productivity and decrease or total loss of incomes, diminishing financial stability; (e) reduction of life contexts and experiences with social isolation and changes in family roles and dynamics; (f) reduced levels of independence and autonomy, and increased need for health care and third-party assistance. Consequently, professional reintegration (PR) is often compromised.

Return to work and the consequent reintegration effort are often not easy tasks after OI, mostly in major cases. However, this effort represents an important part of the recovery process. Work activity helps to maintain physical conditioning, function, self-confidence and quality of life. Absence from work is associated with poor outcomes, including increased morbidity of several health conditions, as mentioned above [77, 107, 108].

Thus, it is of the utmost importance that medico-legal intervention, mainly in the scope of insurance medicine, may allow concrete damage repair, considering the victims' needs satisfaction, including PR, if possible.

Accordingly, to Portuguese labour legislation, the repair of damages and sequelae resulting from an OI, is a right for all workers. Although the responsibility of this damage repair is always in the scope of the employers' responsibility (Law n° 7/2009, December 12th, art. 284°), the legislation offers different configurations, respecting this matter, for public and private sectors of activity. In private sector employers are obligated, by law, to establish contracts with insurance companies for the protecting of their employees in case of OI, transferring the responsibility for damage reparation to the insurance companies (Law No. 98/2009, September 4th). For public sector, and for those workers with a public service work contract, although insurance contracts might be celebrated, the responsibility for of damage reparation is always a of the employer and cannot be transferred for an insurance company (Decree Law No. 503/99, November 20th, Article 4°). In these cases, the damage reparation is assured by the National Pension Fund. In both sectors of activity whenever a rate of Permanent Disability is assigned by the insurance company/ the national pension fund, or when

there is not an attribution of a Permanent Disability and the victim appeals to the labour court because does not agree with the decision, the public prosecutor of the labour court sends the case to a medico-legal evaluation at the National Institute of Legal Medicine and Forensic Sciences of Portugal. In these cases, the final decision is always of the labour court.

Furthermore, Portuguese legislation on labour accidents considers that all victims have the right to be followed throughout their lifespan by the responsible insurance company services for every needs adjustments (e.g., medical appointments, ancillary exams, medicines, treatments, technical aids, third party assistance), and medico-legal personal injury assessment (IA) revision should be performed once per year when necessary (Law No. 98/2009, September 4th, Article 70^o). Thus, medico-legal IA may occur not only at the injury consolidation date but also throughout the victims' lives in a follow-up process, particularly in the major injury cases. To better analyse the outcomes of OI from a medico-legal perspective, the Portuguese IA model may be particularly useful because it offers a detailed and personalized description and quantification of trauma outcomes. Portugal has standardized rules for IA published by the National Institute of Legal Medicine and Forensic Sciences [64, 65], which are followed by both the public and private sectors (including insurance companies). The comprehensive description of personal damages is grounded in the *three-dimensional methodology* (3-DM) [66, 69]. Based on an ecological model, these 3-DM offer a systematic and validated method to describe and examine trauma outcomes. It considers three levels of damage as follows [66]: (a) the *body level*, which assesses biological outcomes with their morphological, anatomical, histological, physiological and genetic particularities; (b) the *capacities level (functions)*, which assesses physical and mental capacities (current or potential), taking into consideration the person's age and sex irrespective of the his or her setting of life; and (c) the *life situations level (participation and activities)*, which assesses the confrontation (concrete or potential) between the victim and the reality of his or her physical, familial, social, cultural, educational and professional environment.

The main objective of this study is to reflect on the role that legal medicine can play in promoting the PR of victims of major occupational accidents through the analysis of OI cases considering the medico-legal examinations performed. Specific aims are to (a) characterize the mechanisms of trauma and injuries; (b) describe the medico-legal permanent professional damage parameters (PPDP), considering the Portuguese rules

on IA; (c) describe the long-term outcomes considering the 3-DM; and (d) analyse which factors are related to PR.

Material and methods

A retrospective study was conducted based on a convenience sample constituted by OI cases followed at a Portuguese insurance company, on the northern region of the country.

Study design is presented in Figure 1, showing that data were collected from two medico-legal assessment moments considering each case: (a) medico-legal PPDP evaluation homologated by a labour court 4.8 years on average after the accident ($SD=6.8$; range between 10 months and 42.7 years); (b) medico-legal follow-up for 3-DM evaluation and personal needs adjustments performed by the insurance company 18.9 years on average after the accident ($SD=9.9$; range between 3.2 and 47.9 years). Criteria for case selection were (a) occupational accident occurred between 1970 and 2013, assuring a length of time between the accident and the medico-legal follow-up ≥ 3 years to allow professional condition stabilization; (b) *Permanent Partial Disability* homologated by a labour court $\geq 40\%$ (assessed by the *Portuguese National Permanent Disability Table* – Annex 1 of the Decree-Law n° 352/2007, of October 23rd), assuming that PR is particularly difficult in major OI; and (c) last medico-legal follow-up report performed between 2016 and 2018 under a uniform protocol and by the same physician with extensive experience with the Portuguese medico-legal methodology to assure data reliability. A total of 103 cases were selected.

For cases that fulfilled these criteria, an anonymous database elaborated by the physician who conducted the medico-legal follow-up was provided.

The *Injury Severity Scale* (ISS) was retrospectively estimated for this study purposes based on injury descriptions in the acute phase in the available clinical files. The results were grouped into the following categories [109, 110]: (a) 0 (non-existent), (b) 1-8 (minor or moderate), (c) 9-15 (serious), (d) 16-24 (severe), and (e) ≥ 25 (critical).

The PPDP considered in Portuguese Labour Law are noted as follows [66]:

- a) *Permanent Partial Disability* (PPD), assigned when there is a functional affectation with repercussions in the victim's earning capacity (n°1 of General Instructions of Annex 1 of the Decree-Law No. 352/2007, of October 23rd); this may be associated with a physical and/or functional

outcome, demanding additional efforts to perform regular work or even the need for workplace adaptation and/or the use of technical aids;

- b) PPD + *Permanent Absolute Disability for Regular Work* (PAD-RW), assigned when the victim presents total disability for a work in the scope of his or her technico-professional qualifications with the need for professional reconversion;
- c) PPD + *Permanent Absolute Disability for Any Work* (PAD-AW), considered in cases of total disability for any type of work without professional reconversion capacity;
- d) *Permanent Needs*, categorized accordingly to several dimensions identified in the literature and clinical practice [66] (Table 5).

Considering the 3-DM, the *Inventory for Handicap Assessment* was used to describe permanent outcomes and to calculate the *Damage Coefficient* (DC) [69]. This coefficient score corresponds to the average of the severity degree of *body*, *functional* and *situational* levels. The result is a 5-level final score [69]: (a) 0 - independent; (b) 1 - independent, but with difficulties; (c) 2 - dependent of medicines and/or technical aids; (d) 3 - partially dependent of third-party assistance (autonomy partially affected); (e) 4 - completely dependent of third-party assistance (without autonomy).

Regarding the concepts of PR and professional reconversion, for the purposes of this study, and considering Portuguese legislation, the following was assumed:

- a) *Professional reintegration or work recovery* means the worker reintegrating in the exercise of a profession (the same as the previous one, or another). In Portugal, in OI cases, this reintegration presupposes the obligation on the part of the employer to ensure that the worker who has suffered an accident at his or her service is occupied in functions compatible with the limitations resulting from the accident (Law No. 98/2009, of September 4th, art. 155^o, n^o 1). Implicit here, therefore, is the notion of remaining capacity and the importance of addressing this aspect in medicolegal terms, considering the rehabilitation and reintegration possibilities;
- b) *Professional reconversion* corresponds to the requalification and reintegration of a worker in an activity that requires a different technical-professional qualification/competence from his or her previous one, taking into account the remaining capacity, school and professional qualifications,

age, and possible needs in terms of adapting to the new workplace, technical aids and professional training.

All analyses were performed using SPSS for Windows (IBM SPSS Statistics, Version 25.0). Descriptive statistics were conducted to analyse the victims' demographics, trauma characteristics and permanent outcomes. The *chi-square test* and *Spearman* correlations were applied to assess the relation between variables of interest. Correlation analyses were performed between the outcomes assessed at the medico-legal follow-up (*body, functional, situational* and *Damage Coefficient* severity degrees), the work-related outcomes (unemployment, early retirement, professional reconversion), and the medico-legal PPDP homologated at a labour court (PPD, PPD+PAD-RW, and PPD+PAD-AW). Correlation analyses were also performed among PR dimensions (professional reconversion, unemployment, and early retirement), the medico-legal PPDP (PPD, PPD+PAD-RW, PPD+PAD-AW), and the ISS as well as the victim's sex and age, using univariate analysis. In all analyses, the level of statistical significance was set at a *p value* of <0.05 .

The study protocol was approved by the Ethics Committee for Health of *Centro Hospitalar de São João/Faculty of Medicine, University of Porto*, Porto. All guarantees of anonymity given were honoured.

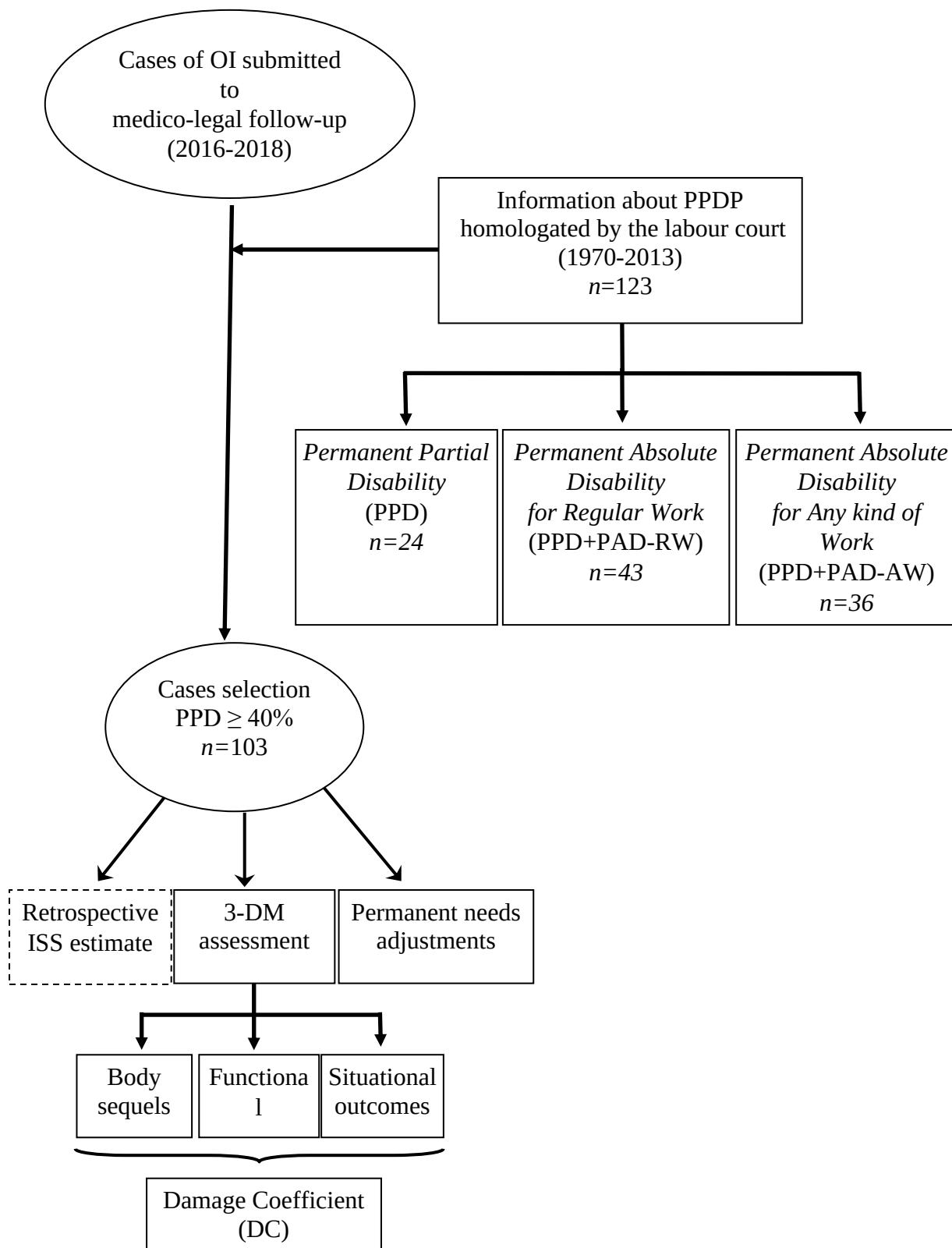


Figure 1. Study design

Results

Victims' demographic characterization

Most of the participants were male ($n=91$; 88.3%). At the time of the accident, the mean age was 35.8 years old ($SD=10.8$; $Min=16$; $Max=59$), and 62.1% were between 25 and 45. Most worked in secondary ($n=56$; 54.4%) or tertiary sectors ($n=43$; 41.7%). Construction workers ($n=44$; 42.7%), operators of plants and machinery ($n=26$; 25.2%), and general services and trade personnel ($n=13$; 12.6%) were the most common occupations involved.

At the time of the medico-legal follow-up, the mean age was 54.3 years old ($SD=10.9$; $Min=23$; $Max=81$).

Trauma mechanism and injury characterization

Different mechanisms of trauma, injury location and injury severity grades are described in Table 1. The ISS was 23.9 on average ($SD=10.3$; $Min=3$; $Max=57$). One of the victims had no physical injuries, but the OI was a psychiatric disorder due to a violent road-traffic accident experience with a great negative impact on his capacity to perform daily life activities.

Table 1. Occupational injury mechanism, severity, and body location (n=103)

		n (%)
Injury mechanism	Fall from elevation	42 (40.7)
	Road traffic accident (<i>in itinere</i>)	32 (31.1)
	Hit by an object	17 (16.5)
	Burn (chemical, electric, explosive, or thermal)	9 (8.6)
	Crush	3 (2.9)
ISS grade	Critical (≥ 25)	57 (55.3)
	Severe (16-24)	35 (34)
	Serious (9-15)	8 (7.8)
	Nonexisting or minor/moderate (1-8)	3 (2.9)
Injury location*	Cranium/brain and/or rachis/spinal cord	76 (73.8)
	Face and/or neck	25 (24.3)
	Chest and/or abdomen	36 (34.9)
	Upper and/or lower limbs	53 (51.5)
	Nonexistent	1 (1)

*Injury location categories are not mutually exclusive.

Medico-legal permanent professional damage parameters

The PPDP homologated by the labour court are described in Table 2. The PPD mean rate for the total sample was 75.4% ($SD=18.5\%$; $Min=40\%$; $Max=100\%$).

Table 2. Professional permanent damage parameters (n=103)

PPDP	n (%)	PPD (%)	
		Mean (SD)	Min/Max
PPD	24 (23.3)	57.7 (8.4)	41.8/76
PPD + PAD-RW	43 (41.7)	69.1 (12.7)	43.0/90.6
PPD + PAD-AW	36 (35)	94.3 (11.3)	52.5/100

Three-dimensional description of permanent outcomes

At the medico-legal follow-up, most of the victims ($n=66$; 64.1%) presented sequelae in two or more body regions (mainly neurological), and mostly had functional repercussions at mobility and pain, as well as professional repercussions (Table 3). Outcome severity assessed by the 3-DM is presented in Table 4.

Table 3. Typology of body, functional and situational permanent outcomes (n=103)

Outcome levels	Outcome types	n (%)
Body*	Neurologic	64 (62.1)
	Orthopaedic	54 (52.4)
	Psychiatric	45 (43.7)
	Dysmorphic	43 (41.7)
	Nephrologic/Urologic	36 (35)
	Ophthalmologic	25 (24.3)
	Reproductive	23 (22.3)
	Otorhinolaryngologic	20 (19.4)
	Dermatologic	19 (18.4)
	Gastroenterologic	14 (13.6)
	Stomatologic	10 (9.7)
	Pneumologic	3 (2.9)
Functions*	Carriage, displacement, and transfer	81 (78.6)
	Pain	81 (78.6)
	Affectivity	67 (65.0)
	Sexuality and/or procreation	51 (49.5)
	Cognition	45 (43.7)
	Senses	42 (40.8)
	Sphincter control	42 (40.8)
	Manipulation and grip	33 (32.0)
	Adaptation to efforts	24 (23.3)
	Weight change	21 (20.4)
	Mastication and ingestion	16 (15.5)
	Communication	15 (14.6)
	Consciousness	13 (12.6)
Situations*	Others	5 (4.9)
	Professional life	90 (87.4)
	Acts of daily living	72 (69.9)
	Other activities (leisure, social, sportive, affective)	69 (67)

**Three-dimensional* outcome categories are not mutually exclusive.

Table 4. Severity of body, functional and situational outcomes (n=103)

Dimensions	Score	n (%)
Body	0 - Nonexistent	1 (1)
	1 - Minimal	4 (3.9)
	2 - Mild	42 (40.8)
	3 - Important	39 (37.9)
	4 - Severe	17 (16.5)
Functions	0 - Without difficulty	0 (0)
	1 - Minimum difficulties (slowness and/or discomfort)	14 (13.6)
	2 - Medium difficulties (medicines and/or technical aids)	59 (57.3)
	3 - Important difficulties (partial third-party assistance)	19 (18.4)
	4 - Impossible (total third-party assistance)	11 (10.7)
Situations	0 - Without difficulty	0 (0)
	1 - Minimum difficulties (slowness and/or discomfort)	21 (20.4)
	2 - Medium difficulties (medicines and/or technical aids)	32 (31.1)
	3 - Important difficulties (partial third-party assistance)	39 (37.8)
	4 - Impossible (total third-party assistance)	11 (10.7)
Damage Coefficient	0 - Independent	0 (0)
	1 - Independent but with difficulties	14 (13.6)
	2 - Dependent of medicines and/or technical aids	39 (37.9)
	3 - Partially dependent of third-party assistance	39 (37.8)
	4 - Completely dependent of third-party assistance	11 (10.7)

Detailed information about current *Permanent Needs*, and *Third-party assistance* typology is described in Table 5. Almost all participants ($n=102$; 99%) presented permanent needs in two or more areas of assistance, mostly medical appointments, medication, and ancillary exams.

Current professional status is described in Table 6, considering the total sample and the PPDP previously attributed.

Table 5. Permanent Needs and Third-party Assistance typologies (n=103)

		n (%)
Permanent needs typology*	Regular medical appointments	102 (99)
	Medication	84 (81.6)
	Regular ancillary exams	82 (79.6)
	Regular treatments	59 (57.3)
	Special transportation	54 (52.4)
	Third-party assistance	50 (48.5)
	Technical aids (including animal aid)	45 (43.7)
	Medical supplies	34 (33.0)
	Home adaptations	27 (26.2)
	Prostheses	17 (16.5)
	Orthoses	15 (14.6)
Third-party assistance typology	Vehicle adaptation	13 (12.6)
	Adapted sport	7 (6.8)
	Total assistance (grade 4)	11 (10.7)
	Partial assistance (grade 3)	33 (32)
	Stimulation or supervision (grade 2)	3 (2.9)
	Vigilance (grade 1)	3 (2.9)

*The needs typologies are not mutually exclusive.

Table 6. Current professional situation at the time of the follow-up – n (%)

	Total	PPD	PPD+PAD-RW	PPD+PAD-AW
Earlier retirement	40 (38.8)	2 (8.3)	2 (4.7)	36 (100)
Unemployment	32 (31.1)	6 (25)	26 (60.5)	---
Prof. reconversion	25 (24.3)	10 (41.7)	15 (34.8)	---
Previous job	6 (5.8)	6 (25)	---	---
Total	103 (100)	24 (100)	43 (100)	36 (100)

Correlations

Correlations, as described in Table 7, were found between the following:

- PPDP (except PAD-RW) and 3-DM levels + DC;
- PPDP and all PR variables;
- 3-DM levels + DC, and early retirement;
- 3-DM situations level + DC, and professional reconversion

Table 7. Study correlations (n=103)

		PPDP (4.8 years after OI)						Current professional outcomes (18.9 years after OI)					
		PPD		PAD-RW		PAD-AW		Unemployment		Early retirement		Professional reconversion	
		ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p
Victims'	sex	-.14	.14	-.03	.78	.08	.45	-.07	.49	.02	.82	-.04	.68
	age	52.6 (63)	.82	.4 (1)	.53	.27 (1)	.60	.3 (1)	.58	.13 (1)	.72	.4 (1)	.51
ISS		.12	.24	.08	.44	-.11	.28	0.03	.74	-.03	.75	-.06	.56
Body		.52	<.001**	2.9 (4)	.58	26.1 (4)	<.001**	8.9 (4)	.06	19.4 (4)	<.001**	0.4 (4)	.98
Functions		.43	<.001**	5.5 (3)	.14	24.9 (3)	<.001**	4.0 (3)	.26	23.8 (3)	<.001**	6.4	.09
Situations		.43	<.001**	6.9 (3)	.07	29.4 (3)	<.001**	3.8 (3)	.28	35.2 (3)	<.001**	19.2 (3)	<.001**
Damage Coeff.		.46	<.001**	7.4 (3)	.06	29.7 (3)	<.001**	3.5 (3)	.32	35.1 (3)	<.001**	17.9 (3)	<.001**
Unemployment		.25	.01 ^a	27.4 (1)	<.001**	21.8 (1)	<.001**						
Early retirement		-.64	<.001**	32.9 (1)	<.001**	78.7 (1)	<.001**						
Prof. reconver.		.35	<.001**	13.9 (1)	<.001**	n.a.	n.a.						

*significant at $p<.05$; ** significant at $p<.001$

Discussion

About the selected sample

The studied sample characteristics are in accordance with the Portuguese official statistics [103] and literature concerning major occupational accidents [32, 59, 111-114].

Major OI in Portugal is more frequent among young males (aged between 25 and 45 years old), as described in other series [111, 115-119]. This fact is of concern because the affectation of the professional active life will be longer than it would be in cases of people near retirement. This finding further highlights the importance of a great investment in PR.

The secondary and tertiary sectors of activity are the most affected (96.1%). The manufacturing industry and construction are the professional activities with the highest incidence of accidents. Considering that work physical demands impose more risks [111, 112, 116, 119-123], the issue of prevention is fundamental here.

The most common mechanisms of general OI are slipping, getting hit by unsharp or sharp objects, being caught in machinery, and falling from heights [116, 123-126]. However, our sample only includes major OI. In these cases, falls from elevation and road traffic accidents are the most frequent mechanisms [120, 125], representing, conjunctly, 71.8% of the cases in this study.

Additionally, in general OI, injuries are mainly orthopaedic in the lower and upper limbs [103, 116, 118, 124, 127, 128]. However, in major cases, most injuries are neurological [113, 129], as observed in our data (62.1%), whereas only 52.4% are orthopaedic (Table 3). One of the victims had no physical injuries but a psychiatric disorder related to the traumatic experience - a road traffic accident with car incarceration. The existence of psychological trauma in several occupational accidents

emphasizes the importance of early psychological and, occasionally, psychiatric treatment in these cases given that the psychological conditions may be prevented. Furthermore, posttraumatic stress disorder, anxiety and depression, among other mental conditions, are linked to more days of work absence, failure to maintain one's job, and poor outcomes concerning return to work [9, 72, 99, 101, 105].

In 89.3%, ISS presented a score ≥ 16 (severe or critical), but no correlation was found between ISS and medico-legal PPDP, PR variables or personal variables. The absence of correlations can indicate a good clinical evolution of the cases, which is favoured because it is a young population. Nevertheless, injury severity is considered a major predictor of work disability [7, 32, 59, 61, 114], and the literature notes that males are more likely to present multiple and severe injuries than females, which results in higher levels of disability [111, 115].

Medico-legal PPDP

Major OI is always associated with some degree of temporary and permanent professional disability. Variables, such as age, injury severity, previous occupation, work absence period and financial compensation system, have been reported as factors related to OI long-term outcomes [72, 81, 130, 131].

Temporary professional outcomes in Portuguese legislation (*Absolut Temporary Disability* and *Partial Temporary Disability*) were not considered for this study given that it focused exclusively on permanent outcomes. However, the period of recovery is of utmost relevance because the length of temporary disability and the early PR are important predictors of permanent outcomes and good indicators of the ability to return to work [61, 83]. Furthermore, being professionally integrated is extremely important for recovery and perceived health status, preventing the emergence of psychological problems, such as depression; therefore, it is a major contribution to improving economic status and increasing sense of utility, social participation, quality of life, and well-being [9-11]. Victims referred to services specialized in rehabilitation focused on promoting return to work have better chances of PR either at previous or new occupations. The absence of an early involvement of a rehabilitation and a PR team working closely with the victim can negatively influence not only the length of time that mediates return to work but also the professional permanent outcome, especially in more severe cases and/or whenever financial compensation is at stake [53, 54, 83]. Thus, this aspect is of great concern and deserves to be analysed.

The PPDP observed in this study was homologated by a labour court 4.8 years, on average, after the OI. According to Portuguese Labour Law (Law No. 98/2009, September 4th), there are two possibilities considering permanent disability assignment (Figure 1):

- a) *Persons without PPD*: injuries cure or consolidate without functional outcomes that may cause professional repercussions with loss of income. In our study, these cases are not represented because a $PPD \geq 40\%$ was assumed as an inclusion criterion;
- b) *Persons with PPD*: when injuries consolidate with functional outcomes causing professional repercussions.

In conformity with the same Law, when a PPD is assigned, there are three possibilities of medico-legal conclusion, as described in Figure 1:

- a) *Persons with PPD*: The victim is clinically considered capable of maintaining his or her usual work or other similar work in the area of his or her technico-professional qualification/competence. This, despite the work, may require increased efforts, some eventual workplace adaptation or even the use of technical aids. In these cases, a loss of gain capacity is assumed. In our study, PPD was assigned in 23.3% of the cases with a mean rate of 57.7%, which is higher than $PPD \geq 40\%$ the criteria for major accidents. Despite that in Portugal small rates of PPD (e.g., 1% to 3%) continue to be noted simply because the specific body sequelae are referred to in the *Portuguese National Permanent Disability Table*, even if there are no functional or professional repercussions that advise it and, therefore, on the contrary provided by law;
- b) *Persons with PPD+PAD-RW*: The victim is not considered able to maintain his or her regular work or other in the area of his or her technico-professional qualification/competence, being a professional reconversion possible, considering the victim's sequelae, remaining capacity, qualifications and age, among others. In our study, this status was assigned in 41.7% of the cases (PPD mean=69.1%). The PPD rate was higher than that found in PPD isolated cases (57.7%). These differences result from the high degree of severity of the outcomes of the cases. However, although, in general, the frequency of annual cases in Portugal is only slightly higher than 1%, all the commitment to PR

remains very important given that a large number of young people can return to an active professional life with support despite the sequelae;

- c) *Persons with PPD+PAD-AW*: The victim is considered completely unable to perform any type of work. In our study, it was assigned in 35% of the cases (PPD mean=94.3%). Although the frequency of this cases is normally low, it represents a high rate of young people who are left without any work capacity, and it is especially important here to rethink PR issues, remaining attentive to the evolution of the rehabilitation and reintegration processes, which can bring new solutions for these persons.

Three-dimensional permanent outcomes

The 3-DM medico-legal analysis was performed 18.9 years on average after OI.

The current *body* severity level was important or severe in 54.4% of the cases (Table 3), although the ISS score was assessed as critical or severe in 89.3% (Table 1). This finding may signify a positive evolution of the more serious cases after clinical and rehabilitation care, and over time, emphasizing the importance of rehabilitation and PR in the OI recovery process [83]. Due to injury typology (Table 1), *body* sequelae were mostly neurological (62.1%), but orthopaedics were also present in more than half of the cases (52.4%) (Table 3). This finding was expected in trauma mainly resulting from falls from elevation [132, 133] and traffic accidents [134, 135].

Current *functional outcomes* (Table 3) reflected mostly on carriage, displacement, and transfer (78.6%); experiencing pain (78.6%); and affectivity (65%).

Current *situational outcomes* (Table 3) were present in the three levels of life considered, but professional life was the most affected (87.4%). The presence of long-term problems of pain, discomfort and mobility have been reported as prevalent outcomes for severely injured workers, even several years after the events [72, 136], which is precisely what we observed although some evolution was also detected. Professional inactivity as a result of OI outcomes was noted in 69.9% of the victims (n=72) due to unemployment or early retirement (Table 6), which appears to be a high rate, even for major cases [103, 137].

Long-term permanent consequences of OI, such as those present in our sample cases, often reflect on increased *permanent needs*, and those have been identified as indicators of failure of PR [61, 138]. Almost all victims have some type of permanent need (99%), and approximately half of them require third-party assistance (48.5%) (Table 5). The

dependence of third-party assistance to perform daily life activities increases in the same direction of *body* sequelae severity and has an important negative impact on PR [10, 11, 72, 99, 139].

A correlation between age and *body* severity was found ($\rho=-.25$; $p=.01$), verifying that younger victims present less severe *body* damage outcomes. The mean age of the victims in our study was 35.8 years at the time of the accident, which might account for this result given that the literature reports that younger age is a protective factor for work capacity [140, 141]. Older victims tend to recover poorly given that more health comorbidities, more physical and functional decline, and less capacity to recover after injury are present. As a result, after OI, older victims tend to have longer periods of recovery, constituting longer periods of work absence, and are more likely to maintain long-lasting outcomes due to health comorbidities and the ageing process [140, 141]. Nevertheless, some discrepancies can be found in the literature regarding the influence of age on work capacity. Studies comparing OI outcomes in younger and older workers observed no relation between age and professional capacity outcomes [117, 142].

Professional outcomes

According to the initial IA, 65% of the victims were considered able to maintain a professional occupation ($n=67$). However, greater than half did not work at the date of the follow-up due to unemployment or early retirement as a consequence of OI (Figure 2).

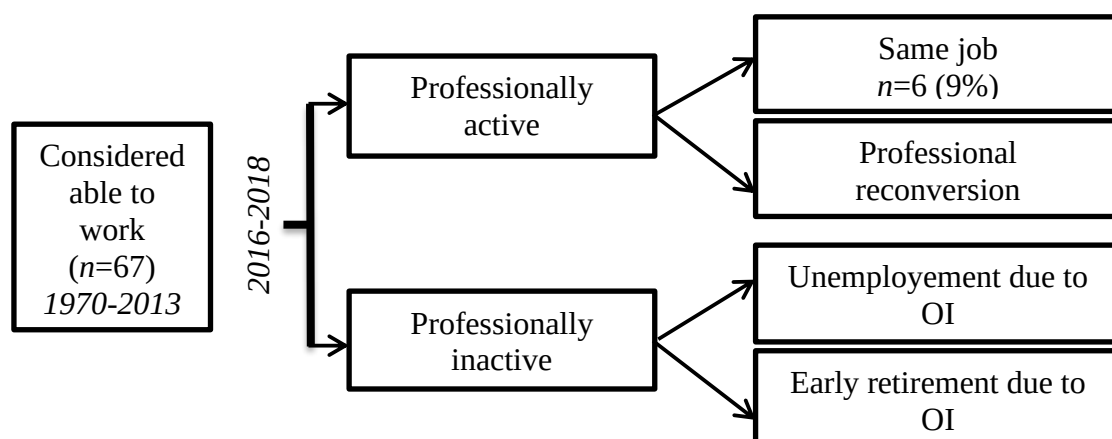


Figure 2. Professional outcome

In the cases assigned with PPD, 33.3% of the victims were not professionally reintegrated (Table 6), which may be due to the various circumstances discussed below. Regarding the cases of PAD-RW, the expected PR was only accomplished in 34.9% (Table 6). These results reflect an important failure on the PR, especially with regard to professional reconversion in cases of PAD-RW, which deserves more detailed studies.

Evidently, these are cases that have evolved for a long time, and at the time of the accident, the solutions to promote reintegration would not be as developed and available as at the present moment. Currently, this topic is still complex, and we know that several factors can explain the difficulty in PR, including the following:

- a) *Personal factors*: Some examples are the lack of motivation for work, the lack of tolerance for pain or other functional limitations, the feeling of lack of strength, the feeling of discomfort when confronting coworkers and supervisors, the lack of educational qualifications and/or professional skills to be integrated into another professional activity or even the high age, preferring to retire, albeit relatively early. In fact, self-perceived health is of extreme importance for PR as well as good physical and psychological health [47, 75]. Furthermore, neurologic sequelae (the most frequent in these major OIs) as well as orthopaedic sequelae are considered predictors for more difficulties in professional performance [113, 143, 144]. Psychiatric sequelae, which was noted in 43.7% of our sample (Table 3), are related to a decrease in work capacity, with the literature showing that posttraumatic stress disorder, depression and anxiety are associated with higher rates of professional disability [9, 10, 99, 145].
- b) *Environmental factors* (social, familiar and professional): Social and familiar support are fundamental for PR [47, 75]. Additionally, workplace accommodations, peer support in the workplace, and flexibility to adjust job responsibilities and schedules to accommodate individuals' functionality have been identified as good predictors of successful return to work [77];
- c) *Access to professional rehabilitation services*: Early access to these services is crucial to promote successful return to work. However, this occasionally does not occur as precocious as it should due to financial compensation systems and the long duration of legal processes, compromising victims' PR [10, 11, 54, 61, 72, 81, 130, 131];

- d) *Financial compensation process*: Workers under financial compensation processes after OI show slower rates of recovery and longer periods of work absence, suggesting a negative influence of legal processes on professional outcomes [53, 72, 146]. Furthermore, financial compensation is directly indexed to permanent disabilities, which can constitute a barrier for victims' engagement and/or referral for PR until PPDP homologation [53, 54].

PR may be compromised not only by one but also by several of these factors, making return to work even more difficult. Personal and social aspects, such as motivation, resilience, social and familial support, and financial stability, are important predictors of *functional* and *situational* outcomes, including PR [61, 147]. The adjustment to the consequences of OI involves mechanisms of cognitive, emotional and behavioural adaptation to cope with the *functional* and *situational* outcomes of the accident. This adjustment can be promoted in cooperation with the medico-legal units of insurance companies, as we will discuss below.

Contribution of the medico-legal IA for PR

Work is an essential dimension of life, ensuring financial stability, social status, a sense of self-confidence, and providing physical and intellectual activity as well as social interaction, which prevent psychosocial isolation and promote emotional stability [9-12]. Work absence, especially if prolonged, and the late start of PR can lead to increased morbidity and health comorbidities, including psychological problems (e.g., depression and anxiety), reduce functional independence and social isolation with a reduction in life settings and life experiences, as well as tremendous effects on the ability to perform professionally and, consequently, prompting financial problems [12, 61]. All these factors can, and often do, increase the costs of workers' legal compensation [72, 77]. Return to work is therefore an important aspect of the OI recovery process, as it can constitute a milestone of restoring a sense of competence and normality in victims and their family's life [9-11, 75]. Thus, early PR in the same occupation or in another adjusted to victims' current functionality is fundamental because it provides (a) context in which coping skills to deal with disabilities can be learned and trained [47, 77]; (b) physical conditioning and functionality improvements [47, 77]; (c) a sense of self-efficacy recapture, allowing the victim to recover self-confidence in his or her abilities and capacities, helping the maintenance of professional activity in the long term [47,

61, 83]; (d) a sense of utility and identity associated with respect and social recognition, increasing social support and contacts, which are extremely important at reducing the risk of depressive and anxious symptoms [75, 84]; and (e) improved quality of life [47, 77].

Efforts at minimizing prolonged work absence and promoting early and adjusted PR require the participation of several professionals of insurance medicine (e.g., medical assistance providers, rehabilitation, psychological and social worker professionals) and occupational medicine, employers, and victims and their families [90]. The early engagement of these multidisciplinary teams has been evidenced as an important predictor of good professional outcome and therefore must be reinforced [32, 53, 54, 59, 83].

According to our experience, we consider that the articulation of the medico-legal experts, especially from the insurance companies, with these multidisciplinary teams would be very useful in some cases to avoid some negative results, as we found in the present study. Despite having found high correlations between the PPDP and the PR variables (Table 7), suggesting that PPDP are a good measure of the victims' work capacity, we found that after a length of time of 18.9 years, on average, 65% of the victims who were considered able to work by the medico-legal experts (with the labour court homologation) were not professionally active (Figure 2). This finding leads us to question whether the problem is related to (1) the multiplicity of factors that could explain the difficulties in return to work, or even the no return, above referred [9, 11, 61, 72, 75, 77, 81, 99, 113, 131, 144, 146]; (2) the absence of an adequate PR plan before the medical discharge and the medico-legal IA; and (3) the medico-legal IA, which is many times out of step with the real job context of the victim. Most likely, all these aspects are involved in the final result. However, legal medicine cannot exempt itself from its responsibilities, and it is important that it is open to new and better methods of evaluating these cases, mainly the cases that may be assigned as PAD-RW. In Portugal, PPDP assessment is very relevant and mandatory by law. However, in the majority of cases, PPDP evaluation relies exclusively on the *National Permanent Disability Table* and only considering the *body sequelae*. This type of procedure may explain, at least, part of the obtained results (mainly in the cases assigned as PAD-RW). In fact, each person represents a particular reality where the body is just one part to be assessed. The different contexts of life of each person (environmental factors, as proposed by the International Classification of Functioning, Disability and Health

[148]) must also be considered in the evaluation [69]. In the special cases of OI, all the aspects that are work-related need to be taken into consideration with great care and attention. These aspects were not considered in the cases assessed between 1970 and 2013, particularly the oldest ones. Thus, we believe that we could have found a better agreement between this assessment and the professional victims' situation between 2016 and 2018.

This articulation of the medico-legal expert with the PR team may be very important at promoting the victims PR given the following reasons:

- a) Often, in cases that arrive at IA without any attempt to return to work, there may be scope to promote a last PR attempt through articulation with a PR team. For that purpose, we may consider that 3-DM evaluation provides a consistent, comprehensive and integrated view of the accident outcomes and permanent needs that can be very informative about professional capacity and/or the need for PR. Thus, it should always be considered part of the evaluation, allowing the expert to discuss in detail with the victim about his or her professional activities and proposing solutions that can be tried in the context of an attempt at PR, considering the functional limitations observed at the IA. This will be particularly important in cases of PAD-RW, which are the most complex and, as shown in this study, did not correlate with 3-DM (Table 7). Furthermore, the detailed description of the person and the interaction of his or her capacities/functionality in different contexts is an excellent tool for communication and articulation between all parts: medico-legal experts, professionals of rehabilitation and reintegration, occupational physicians, workplace advisors, insurance companies and even labour courts. This methodology should comprise the first medico-legal IA as well as the subsequent follow-up;
- b) Experts have long experience and specialized methodologies that can assist in the detection of simulation or exaggeration of OI damages due to expectation of higher financial indemnity [138, 146]. The value of financial reparation is often related to the degree of disability presented by the victim and its inability to perform a professional duty that assures financial incomes; therefore, some victims might show some resistance in being reconverted or reintegrated before the closure of legal processes, losing the benefits of an early PR for the health and recovery process [9-11]. In fact, an increased risk of negative outcomes has

been reported when financial compensation of OI resulting sequelae is at stake [53, 54, 72, 146];

- c) Medico-legal follow-up of the major OI victims by the medico-legal staff of the insurance companies, as established by Portuguese legislation (Law nº 98/2009, September 4th, art. 70º), is an important measure to accompany victims throughout their lives, especially in the first years after the accident: (1) assisting recovery and establishing the path towards reintegration; (2) assessing the long-term outcomes; (3) recognizing and responding to the required assistance to cope and deal with them; and (4) informing and promoting PR.

In those cases, the challenge needs to be faced with a multidisciplinary team of service providers and medico-legal staff, where insurance companies, vocational rehabilitation centres, occupational medicine, and companies must work in a joint, structured, and integrated manner to support the effective PR of the victims.

Limitations of the study and further studies

The small sample size and the methodological limitations inherent to a retrospective study design constitute the limitations of the study. Furthermore, some variables that have been established to be related to PR [72, 117, 134, 146] and that could assist us in a better understanding of the results, such as education level, socioeconomic status, psychosocial indicators, psychological status, job demands, professional rehabilitation, and social support, were not collected. Given the retrospective nature of the study, we only used available information. Information related to other follow-up assessments of each case as well as of rehabilitation interventions that have eventually occurred in this gap of 18.9 years could also have guided us to better understand the victim's evolution regarding their sequelae.

To better understand OI outcomes and to find solutions aiming for better results in PR, namely, those involving the early intervention of multidisciplinary PR teams, including the medico-legal expert, further studies concerning the relation of emotional, psychosocial and social factors and PR, temporary professional disability, and professional reconversion in cases of PAD-RW are needed.

Conclusions

According to our sample, in major occupational accidents:

- a) Victims were mostly men (88.3%), those aged between 25 and 45 (62.1%), and secondary and tertiary sector workers (96.1%);
- b) Falls from elevations and road traffic accidents were the principal injury mechanism with most of the injuries located at the brain and spinal cord (73.8%) with an ISS score of severe or critical (89.3%);
- c) Permanent long-term outcomes were principally associated with neurological (62.1%) and orthopaedic (52.4%) sequelae;
- d) The global PPD mean was of 75.4% (*Min*=40%; *Max*=100%);
- e) Considering the PPDP homologated at a labour court 4.8 years, on average, after the accident, cases were assigned to PPD (23.3%), PAD-RW (41.7%) and PAD-AW (35%), presenting mean rates of 57.7%, 69.1% and 94.3%, respectively.
- f) Considering 3-DM assessed 18.9 years, on average, after the accident, 48.5% of the victims presented a DC in levels 3 and 4 of severity at the follow-up exam with 99% having permanent needs;
- g) 3-DM is helpful for predicting PPD and PAD-AW;
- h) 3-DM did not reveal correlations with PAD-RW, and currently 65% of the victims who were considered able to work by the labour court are not professionally active. Thus, these major cases deserve a more detailed medico-legal approach based on concrete information about the professional reality of each victim.

Medico-legal IA must be based on concrete aspects of the victim's professional reality and not only on permanent disability tables. This calls for an articulation between all institutions working with victims of OI, including medico-legal experts of the insurance companies, to promote recovery and the necessary measures to assure the PR in the same or in other professional activity according to the victim's remaining physical and psychological capacity and his or her previous skills.

1.1. Corrigendum to ‘The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution

The work described in this Chapter was published in Corrigendum to The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution – Journal of Forensic and Legal Medicine, authored by Isabel Almeida^{1,2}, José Manuel Teixeira³, Teresa Magalhães^{1,3,4}.

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The authors regret that the data reported in the article introduction, relating to 2019 Portuguese occupational accidents, weren't accurate. In 2019, Portugal registered a total of 196.202 occupational accidents that were fatal in 104 cases. The incidence rate of nonfatal accidents was 4.105,7/100.000 workers with temporary consequences requiring work absence in 138.813 cases (70.8%).

The authors would like to apologise for any inconvenience caused.

2. Relationship between psychological symptoms and professional reintegration after an occupational accident: a Portuguese cross-sectional forensic study

The work described in this Chapter was published in Relationship between psychological symptoms and professional reintegration after an occupational accident: a Portuguese cross-sectional forensic study - Forensic Sciences Research, authored by: Isabel Almeida^{1,2,*}, Pedro M. Teixeira³, José Manuel Teixeira⁴ and Teresa Magalhães^{1,5-7}, doi: 10.3788/tfsr20250001

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Abstract

Occupational accidents (OAs) are stressful life events with the potential to trigger temporary or long-lasting psychological symptoms that can affect the capacity to resume work and/or the extent of permanent professional disability (PD). This study aimed to analyse the relationship between psychological symptoms reported at the end of the OA recovery and rehabilitation process and both professional reintegration and PD. A cross-sectional study using a convenience sample ($n=101$) was conducted over a 6-month time span at a Portuguese insurance company after the medico-legal examination. The participants underwent a semi-structured interview and completed self-reported psychological measures. Information regarding current professional status

(active vs. inactive) and the assignment of a PD rate (with vs. without) was collected. Most of the participants (80.2%) were already professionally active, and 54.5% were assigned a PD. With respect to the psychological measures, the participants reported a moderate or above level of self-perceived in the following: emotional pain (71.3%); difficulties at work and social adjustment (WSA) (61.4%); anxiety (40.6%); and depression (35.6%). Reported symptoms of depression and WSA difficulties were greater in the professionally inactive group and were correlated with professional status. Reported symptoms of WSA difficulties were shown to be good predictors of professional status. The PD-assigned group presented higher WSA difficulty levels and was a good predictor of PD attribution. The findings shed light on the potential impact of reported depression symptoms and WSA difficulties on professional reintegration, stressing the importance of psychological assessment and support (when needed) during recovery and professional rehabilitation processes.

Key points

- Occupational accidents are stressful life events with the potential to trigger psychological symptoms
- This study showed that psychological statuses, especially depression and work and social adjustment difficulties, can affect professional status and professional disability.
- Psychological assessment of injured workers, during recovery and professional rehabilitation phases, is important to provide (when needed) psychological treatment to enhance the odds of recovery and of successful return to work.

Keywords: forensic sciences; occupational accident; psychological symptoms; professional outcomes; medico-legal outcomes; professional rehabilitation; professional reintegration

Introduction

Regardless of each country's legislation, occupational accidents (OAs) correspond, in clinical terms, to traumatic events that occur in a sudden and unforeseen manner, are of external origin to the constitution of the victim, and are related to work. These events result in acute injuries to physical and/or mental integrity with the potential to cause

death or functional sequelae that can permanently affect an individual's physical and psychological health and well-being [2-4].

OAs are a global cause of death, morbidity and disability with enormous personal, social and economic impacts [6, 7, 23, 149, 150]. One of these negative impacts is related to the repercussions of permanent physical outcomes in professional reintegration [32]. However, it is also important to consider the impact of psychological symptoms that can emerge after OA because they can be equally disabling [9, 33, 34]. Adapting to these short- or medium-term personal and professional changes requires physical, cognitive, emotional, and behavioural adjustments, which can affect the recovery process and the psychological stability of injured workers [50, 57, 61, 151, 152]. These stressful and potentially traumatic events can, among other things, trigger changes in workers' thoughts and feelings about themselves and about the world around them, leading to psychological mechanisms such as catastrophizing, helplessness, perceived injustice and disability, rumination, demotivation, altered perceptions of personal capacities and a reduced sense of control, all of which are cognitive and emotional processes known to be linked to poorer mental health [41-45]. All these changes can lead to reduced functional capacity, which may delay or even prevent a successful return to work.

Psychological symptoms that may arise after an OA include, among others, asthenia and adynamia (associated with inactivity), the perception of personal vulnerability, emotional distress, pain and instability, manifestations of anxiety, depression, or fear about the future, sleep disorders, somatic complaints, behavioural disturbances associated with interpersonal conflicts (namely intimate partner violence), substance use dependencies, and subclinical or clinical posttraumatic stress disorders [35, 39, 40]. Although these psychological symptoms may not appear or may be mild and temporary for some injured workers and may disappear over time without the need for specialized help, they can be more severe and persist for others, requiring treatment to prevent or reduce permanent mental health disorders. If these disorders become permanent, they will affect workers' well-being and work capacity, compromising professional reintegration outcomes and increasing the odds of a permanent professional disability (PD — in Portugal, according to No. 1 of General Instructions of Annex 1 of the Decree-Law 352/2007, October 23, it refers to the percentage of functional affectation, which impacts work and earning capacity, as a result of OA sequelae [66, 74]).

In Portugal, PD is assessed at the end of OA recovery and rehabilitation process, when a final personal injury assessment (PIA) is conducted at the insurance company that assumes the responsibility for the accident, and consequently for the treatment, rehabilitation and professional reintegration of the injured worker (Law No. 98/2009, September 4). Typically, the initial recovery period, after the OA, is associated with a total inability to work (temporary total professional disability, TTPD) [66]. When physicians consider that it is possible to begin professional rehabilitation, victims are sent back to work but, in general, they maintain medical insurance support, namely, for rehabilitation; in these cases, a rate of temporary partial professional disability (TPPD) is assigned by the clinician and is periodically reassessed (by adapting it to the respective worker's clinical situation and the type of professional activity) [64, 66]. When clinicians believe that the professional rehabilitation process has been completed, they send the victim to undergo a PIA, which is performed by a medical expert from the responsible insurance company. This expert prepares a PIA report according to official Portuguese rules [65, 66], where, among other things, the current professional status and the presence, or absence, of a PD and, if applicable, its rate and typology, are defined. When present PD can be of three types: permanent partial disability (PPD), there is capacity to resume the essential part of previous tasks, albeit with increased effort and/or some technical adaptations [74]; permanent absolute disability for regular work (PAD-RW), there is a total inability to perform previous work and professional reconversion (workers' requalification and reintegration into a different professional area) is needed [66, 76]; permanent absolute disability for any work (PAD-AW), there is a total disability for any type of work, with professional rehabilitation and reconversion determined to be unfeasible. In our country the legal process of personal damage assessment and reparation continues after this through the Public Prosecutor Office, as described in Figure 3, until a final decision is made at labour court.

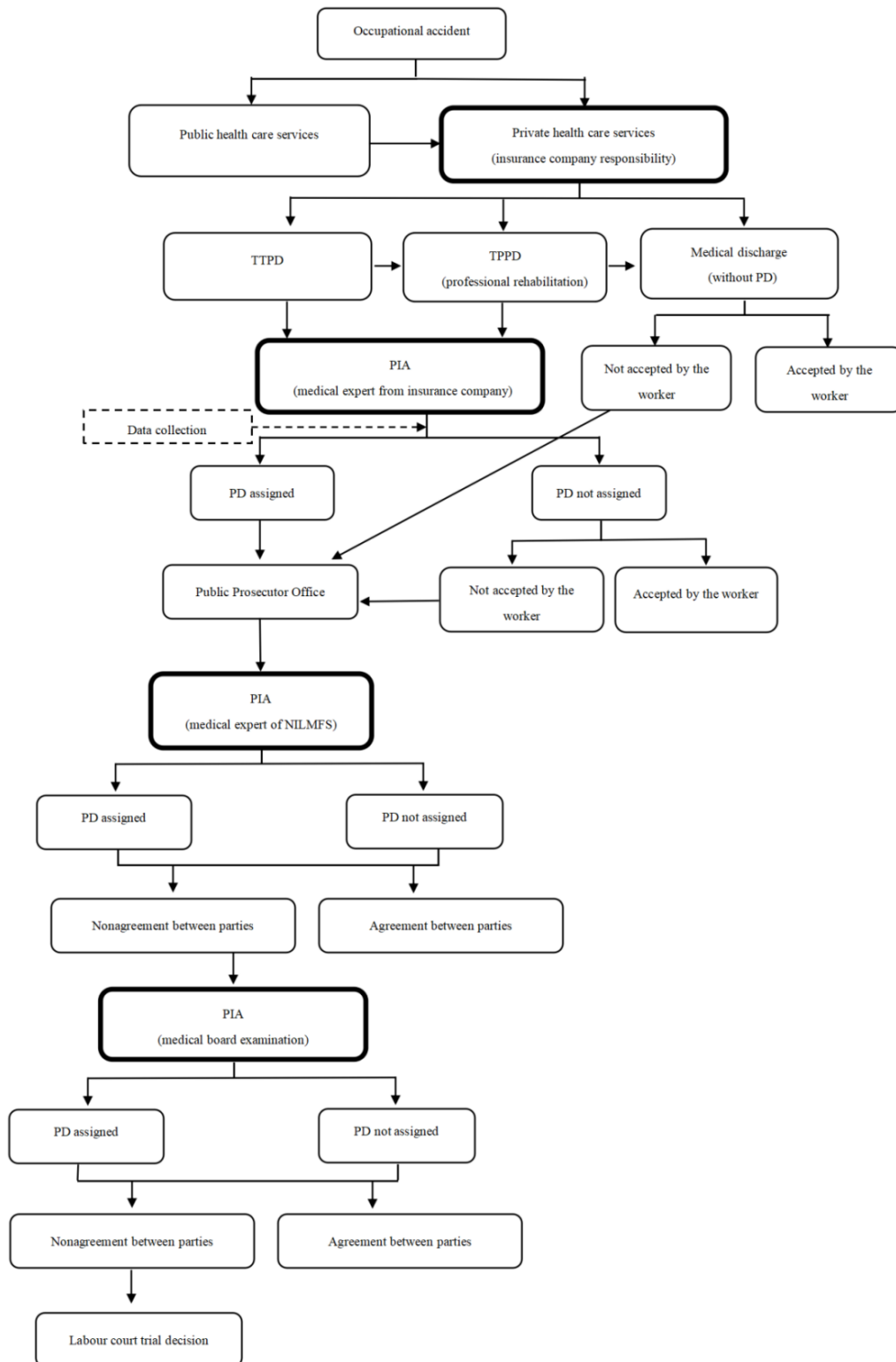


Figure 3. Portuguese system after an occupational accident (treatment and PIA to support eventual personal damage reparation).

With or without a PD, professional reintegration is one of the most important aspects after an OA and can be mediated by several factors. Common factors that have been associated with poor professional reintegration outcomes are being older; being female; experiencing previous sick leave and unemployment; having high levels of pain and disability; having depression; having anxiety; having high physical work demands; and experiencing perceived limitations in performing daily life and professional activities [9, 36, 49, 60, 61, 89]. However, higher education and socioeconomic status, higher self-efficacy and optimistic expectations about recovery and return to work, low injury severity, coordination of the professional reintegration process, and multidisciplinary interventions that include the workplace and stakeholders were found to be factors associated with good outcomes in terms of professional reintegration [9, 36, 49, 60, 61, 89]. Employers and workplace conditions also have an important role in professional reintegration. The early engagement of employers in professional rehabilitation and reintegration, along with perceived workplace peer support, accommodations, and flexibility in adjusting job responsibilities and schedules to accommodate individuals' functionality resulting from OA, produces a sense of psychological safety and security in injured workers that has been established as a good predictors of successful professional reintegration [32, 53, 54, 59, 77, 83].

Regarding the relation between psychological symptoms, professional reintegration and PD, scientific evidence has been revealing worrying facts: (1) OA injuries that require more than a week off work are more likely to produce long-term impairments to workers' physical and mental health and well-being [40]; (2) OA victims have an overall worse mental health status than the general population, with higher levels of depression, anxiety, and pain scores 1 month after the event, and these outcomes negatively impact both the odds of recovery and the return to work [37, 39, 48, 80, 153-156]; (3) depression prevalence on OA victims' can range between 6%–42%, and anxiety between 4%–24% [38]; (4) injured workers with depression are less likely to be at work 6 months after the OA than non-depressive injured workers (52% vs. 73%) [35, 78, 79]; (5) the presence of severe psychological symptoms within 1 year after the OA is a significant risk factor for non-return to work, even 6 years after the injury [9]; (6) higher depression scores 1 month after the OA reduces the odds of return to work in a range between 2 and 12 months [157]; and (7) higher self-reported functional disability and the presence of depression are associated with lower odds of successful professional reintegration after workplace injury [58].

Given the influence of psychological symptoms on return to work and on work capacity, psychological assessment after an OA is extremely important because victims often experience psychological distress that is detectable and treatable.

This study primarily aimed to analyse the relationship between psychological symptoms at the end of the OA recovery and rehabilitation process, and two outcomes: professional reintegration and PD. The specific objectives are to (1) characterize participants and trauma; (2) characterize professional situation and PD assignment (PIA results); (3) describe the participants' psychological statuses, with a focus on reported symptoms of emotional pain, anxiety, depression, and work and social adjustment (WSA) difficulties; and (4) analyse the relationships between these reported psychological symptoms and professional reintegration outcomes as well as the PD assignment.

Participants and methods

Participants

We recruited injured workers at the end of the OA recovery and rehabilitation process as our participants. Given the fact that in Portugal all injured workers are assisted by insurance companies before professional reintegration, for this study, this was the only context where our participants could be recruited. Therefore, this source of subjects should not be considered a bias in the study and its results.

The criteria for participant selection included the following: (1) OA victims, regardless of sex, age, or profession; (2) being at the end of the OA recovery and rehabilitation process (already having undergone a final PIA by a medical expert from an insurance company, with the respective report available for consultation); and (3) those with the capacity to consent to participate and respond to clinical interviews and self-administered questionnaires, as assessed by a clinical psychologist. The exclusion criteria were (1) health comorbidities and pre- and post-OA pathologies that could confound responses and (2) the existence of diagnoses of anxious and/or depressive disorders before the OA. The average time span between the OA and the day of the final PIA and study data collection was 201.5 days (standard deviation (SD)=121.2; Min=51; Max=789). A final sample size of 101 participants was obtained.

Methods

A cross-sectional study was conducted using a convenience sample over a 6-month period. Written informed personal consent from the participants and approval of the study protocol by the Ethics Committee of the Faculty of Medicine of Porto University were previously obtained (No. 232/19, 2019 July 19th).

Those who met the inclusion criteria were invited to participate and were assured that the study was unrelated to the insurance company's process. After providing written informed consent, the participants underwent a semi-structured interview conducted by an experienced clinical psychologist proficient in clinical evaluation and professional reintegration that assessed their capacity to participate.

Sociodemographic aspects, including age, sex, educational level, marital status, and profession, were evaluated.

The injury severity level was estimated through PD rates assigned by the insurance company PIA according to the following scale [73]: (1) 0: non-existent; (2) 1–5: minor; (3) 6–15: moderate; (4) 16–40: serious; (5) 41–70: severe; and (6) >71: critical.

Emotional pain was assessed using a subjective self-reported measure, in which participants were asked to rate, on a 6-point Likert scale from 0 (none) to 5 (maximum), their current perceived level of emotional pain and suffering related to the experience of OA and its sequelae. Although this scale is not a standardized psychometric instrument, we decided to use it based on the need for a simple, short, intuitive, and direct assessment of participants' present personal experience of suffering.

The participants subsequently completed the following self-administered standardized instruments in a varied order of administration to mitigate fatigue and order effects:

a) Work and Social Adjustment Scale (WSAS)

This is a self-report scale used to assess the impact of a person's perceived mental health on his or her ability to function in five life domains (home management, work, social leisure, private leisure, and personal or family relationships) [158]. It uses a 9-point Likert scale ranging from 0 (not at all) to 8 (very severely). The instrument revealed good internal consistency under various conditions of use ($\alpha=0.79-0.94$), as well as a good test-retest correlation ($r=0.73$), in its original validity study [51]. The Portuguese form has adequate internal consistency ($\alpha=0.87$) [159]. The scale maximum score is 40, with higher scores representing more difficulties. The results are scored according to three levels of severity: (1) <10: subclinical population; (2) 10–19: significant WSA

difficulties but less severe clinical symptomatology; and (3) ≥ 20 : moderate to severe WSA difficulties or worse psychopathology. In this study, this scale was used to assess how participants perceived that their mental health influenced their WSA after the OA.

b) Generalized Anxiety Disorder Questionnaire (GAD-7)

The GAD-7 is a short scale used as a screening tool and as a severity measure for generalized anxiety disorder [160]. It has a unidimensional structure that corresponds to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) diagnostic criteria for generalized anxiety, including: (1) feeling nervous, anxious or on edge; (2) not being able to stop or control worrying; (3) worrying too much about different things; (4) trouble relaxing; (5) being so restless that it is hard to sit still; (6) becoming easily annoyed or irritable; and (7) feeling afraid, as if that something awful might happen. The participants are asked to evaluate their level of symptoms in the past 2 weeks using a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day). The maximum score is 21, with higher scores representing more severe symptoms. The severity criteria were as follows: (1) ≤ 4 : normal; (2) 5–9: mild; (3) 10–14: moderate; and (4) ≥ 15 : severe. A cut-off point of 10 was established as the score indicating the presence of significant anxiety symptomatology. The Portuguese version, which was used in this study, has good psychometric proprieties ($\alpha=0.88$) [161].

c) Patient Health Questionnaire (PHQ-9)

This 9-item scale is a simple and short screening instrument for depressive symptomatology. The items are based on DSM-IV criteria: sleep, fatigue, appetite and concentration problems, agitation/retardation, anhedonia, depressed mood, self-devaluation, and suicide ideation [162]. It uses a 4-point Likert-type scale ranging from 0 (not at all) to 3 (nearly every day). In its original study, it has shown good internal consistency ($\alpha=0.86$ – 0.89) and test-retest validity ($r=0.84$) [162]. The maximum score is 27, with higher scores representing more severe symptomatology. The degrees of severity were defined as follows: (1) 0–4: minimal; (2) 5–9: mild; (3) 10–14: moderate; (4) 15–19: moderately severe; and (5) ≥ 20 : severe. The Portuguese version, which was made available by Pfizer (www.phqscreeners.com), showed good internal consistency ($\alpha=0.86$), and a score of 9 was determined as the cut-off point for the presence of depression [163–165].

All self-administered instruments used in this study revealed good internal consistency with our sample ($\alpha \geq 0.70$).

Statistical analyses

All the statistical analyses were conducted using SPSS for Windows version 25.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were employed to characterize the participants' demographic characteristics, accident mechanisms, injury location and severity, current professional status, PD typology and rates, and psychological symptoms (emotional pain, WSA, anxiety, and depression levels).

To explore differences in psychological symptomatology between professional reintegration outcomes, participants were categorized into two groups: active (victims who had already resumed professional activity, either in the same or different fields) and inactive (victims not currently engaged in professional activity for reasons such as unemployment, sick leave, or retirement). An independent sample *t*-test was conducted to evaluate potential differences in psychological symptomatology between active and inactive participants.

In the analysis of psychological symptoms among PD outcomes, the participants were categorized into two groups: those with PD (comprising victims assigned with PPD, PAD-RW, and PAD-AW) and those without PD. Independent sample *t*-tests were conducted to evaluate potential differences in psychological symptomatology between participants with and without PD.

Correlations between psychological symptoms (emotional pain, WSA, anxiety, and depression levels), sociodemographic variables (age, sex, education, and marital status), injury severity variables, and both PD and professional status groups were assessed using Spearman and chi-square analyses.

Binary logistic regression was employed to analyse the relationships between emotional pain, anxiety, depression, and WSA symptoms and the likelihood of professional inactivity, as well as the probability of PD assignment, while controlling for age, sex, education, and injury severity. Odds ratios (ORs) were estimated with a 95% confidence interval (95%CI). For all the analyses, statistical significance was set at a *p*-value of less than 0.05.

Results

Participant and trauma characterization

At the time of the accident, the participants' mean age was 44.7 years (SD=11.2; Min=18; Max=69). The majority were male ($n=84$; 83.2%) and most were married ($n=69$; 68.3%). The average schooling duration was 8.7 years (SD=3.4; Min=3; Max=17), with most of the participants ($n=68$; 67.3%) having a low level of education (≤ 9 years). General services and trade personnel ($n=29$; 28.7%), building workers ($n=25$; 24.8%) and operators of plants and machinery ($n=20$; 19.8%) were the most common occupations at the time of the OA. The OA mechanism and injury location and severity are described in Table 8.

Table 8. Occupational accident mechanism, injury location and severity ($n=101$).

Category	<i>n</i> (%) ^a
<i>Accident mechanism</i>	
Effort trauma	24 (23.8)
Fall from own height	21 (20.8)
Hit by a sharp object	14 (13.9)
Crush	12 (11.8)
Fall from height	11 (10.9)
Road traffic accident (<i>in itinere</i>)	11 (10.9)
Hit by a blunt object	6 (5.9)
Burn	1 (1.0)
Dog bite	1 (1.0)
<i>Injury location^b</i>	
Upper limbs	51 (50.5)
Lower limbs	45 (45.5)
Raquis/spinal cord	14 (13.9)
Face and/or neck	4 (4.3)
Cranium/brain	3 (3.0)
Chest and/or abdomen	3 (3.0)
<i>Injury severity</i>	
Non-existing	46 (45.5)
Minor	26 (25.7)
Moderate	21 (20.8)
Serious	6 (5.9)
Severe	2 (2.0)
Critical	—

^aPercentages may not add up to 100 due to rounding.

^bInjury location categories are not mutually exclusive.

Professional status and PD characterization (PIA results)

The professional situation at the end of the OA recovery and rehabilitation process at the insurance company is presented in Figure 4, which shows that the great majority of participants were professionally active.

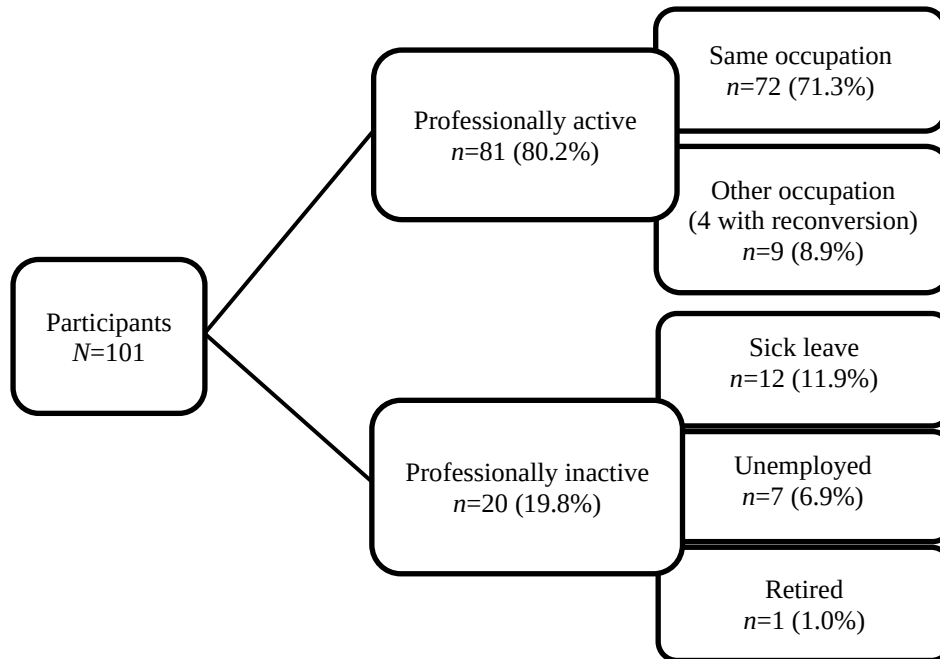


Figure 4. Professional status at the time of final PIA at the insurance company

Figure 5 reveals that more than half of the participants ($n=55$) were assigned a PD (PPD+PAD-RW), but none was considered totally incapable for work (PAD-AW).

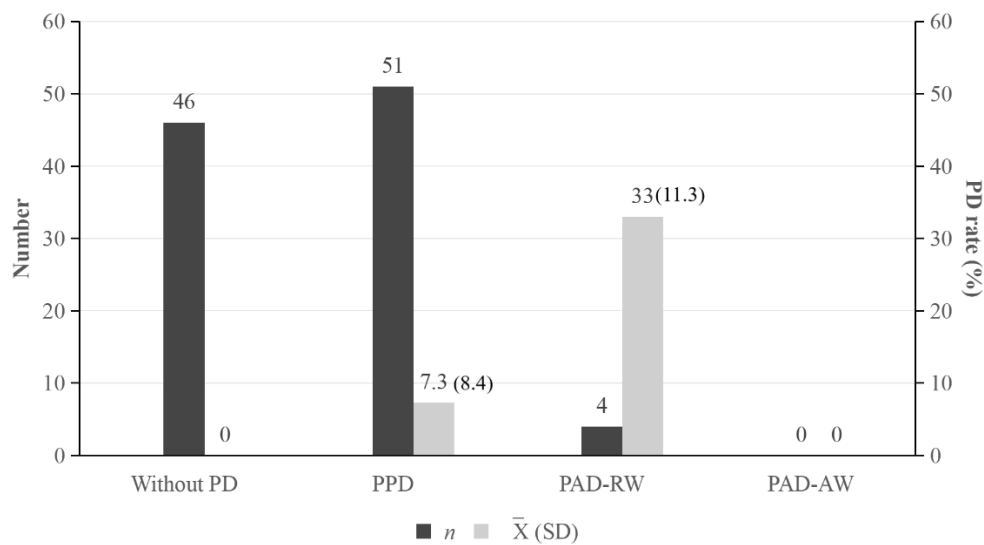


Figure 5. PD assigned at PIA at the insurance company (n and PD rate - $\bar{X}$ (SD) by typology).

Participants' psychological statuses at the end of the professional rehabilitation phase

Emotional pain was reported by 87.1% of the participants, and its rate was equal to or greater than moderate for 71.3% ($\bar{X}=2.8$; $SD=1.4$). WSA difficulties were rated as moderate or severe by 61.4% ($\bar{X}=14.1$; $SD=11.1$). Anxiety symptoms were reported by 68.3% of the participants, with an average score of 8.7 ($SD=5.6$); 40.6% rated these symptoms as moderate or severe. Depression symptoms were reported to be above the cut-off point (≥ 9) by 35.6%, with an average score of 8.2 ($SD=6.4$). The results are detailed in Table 9.

Table 9. Psychological symptoms (n=101).

Symptoms	<i>n</i> (%) ^a
Emotional pain	
Inexistent	13 (12.9)
Minimal	7 (6.9)
Slight	9 (8.9)
Moderate	44 (43.6)
Intense	20 (19.8)
Maximum	8 (7.9)
Work and social adjustment (WSAS)	
Subclinical	39 (38.6)
Moderated	35 (34.7)
Severe	27 (26.7)
Anxiety (GAD-7)	
Inexistent	32 (31.7)
Mild	28 (27.7)
Moderate	18 (17.8)
Severe	23 (22.8)
Depression (PHQ-9)	
Minimal	37 (36.6)
Mild	28 (27.7)
Moderate	16 (15.8)
Moderately severe	16 (15.8)
Severe	4 (4.0)

^aPercentages may not add up to 100 due to rounding.

Comparisons

Compared with the inactive group, the professionally active group had statistically significant lower levels of depression and WSA difficulties (Table 12).

With respect to PD, WSA difficulties were statistically significantly worse in those assigned a PD (Table 12). Despite not being statistically significant, participants to whom PD was assigned had an average score for depression above the cut-off point ($\bar{X}$ =9.1; SD=6.6), which did not occur in the group without a PD ($\bar{X}$ =7.1; SD=6.1).

Table 10. Comparisons of psychological symptoms between groups (n=101).

Psychological symptom	Professional status						PD					
	Active		Inactive		<i>t</i> (99)	<i>P</i>	Assigned		Non assigned		<i>t</i> (99)	<i>P</i>
	$\bar{X}$	SD	$\bar{X}$	SD			$\bar{X}$	SD	$\bar{X}$	SD		
Emotional pain	2.7	1.4	2.9	1.7	0.6	0.58	2.9	1.4	2.5	1.4	1.3	0.19
Anxiety	8.3	5.7	10.3	5.3	-1.5	0.14	9.3	5.9	7.9	5.2	1.2	0.22
Depression	7.6	6.1	10.9	7.1	-2.1	<0.05*	9.1	6.6	7.1	6.1	1.6	0.12
WSA	12.4	10.2	21.1	11.7	-3.3	<0.05*	16.9	10.7	10.7	10.6	2.9	<0.05*

* significant at $p<0.05$;

Correlations

For sociodemographic aspects, significant correlations were found only between WSA and marital status. No correlations were found between injury severity and psychological measures. All the psychological measures are correlated with one another. All these results are shown in Table 11.

Table 11. Correlations between psychological measures and age, sex, education, marital status, injury severity, professional status and PD (n=101).

Category	Depression		Emotional pain		Anxiety		WSA	
	ρ	<i>P</i>	ρ/χ^2 (<i>df</i>)	<i>P</i>	ρ	<i>P</i>	ρ	<i>P</i>
Age	0.12	0.25	0.04	0.71	0.78	0.44	0.60	0.55
Sex	0.15	0.15	0.12	0.23	0.19	0.56	0.12	0.23
Education	-0.47	0.64	0.04	0.72	0.12	0.24	0.05	0.62
Marital status	-0.47	0.64	-0.11	0.27	-0.10	0.32	-0.25	0.01*
Injury severity	0.02	0.86	-0.10	0.92	-0.24	0.81	0.17	0.09
Professional status	0.21	<0.05*	4.99 (5)	0.42	0.14	0.15	0.29	<0.05*
PD	-0.17	0.09	2.55 (5)	0.77	-0.10	0.30	-0.32	0.001**
WSA	0.67	<0.001**	0.47	<0.001**	0.63	<0.001**	—	—
Anxiety	0.75	<0.001**	0.37	<0.001**	—	—	—	—
Emotional pain	0.36	<0.001**	—	—	—	—	—	—

* significant at $p<0.05$; ** significant at $P<0.001$

Logistic regression

The results show that WSA is a significant predictor of the likelihood of being professionally inactive (OR=1.069; 95%CI=1.03–1.13; $P<0.05$), with higher levels of WSA difficulty reducing the odds of being active. Similar results were found for the probability of being assigned a PD, with WSA difficulties being a good predictor (OR=0.945; 95%CI=0.909–0.984; $P<0.05$).

Demographic variables and other psychological measures (i.e., depression, anxiety, and emotional pain) had no significant influence on either professional activity or PD assignment.

Discussion

Our study revealed that most participants reported relevant levels of psychological symptoms at the end of the OA recovery and rehabilitation process. These symptoms were more severe in individuals who remained professionally inactive (20%), in accordance with other studies [35, 36, 47, 75, 77].

Participants and trauma

The victims were primarily young men ($\bar{X} = 44.7$ years). This finding is consistent with official Portuguese statistics [166] and the international literature [115-117, 119, 167, 168].

The professions most frequently involved were those in more physically demanding areas of activity, where the risk of sustaining traumatic injury is higher. Our results of injuries cause and location (effort trauma, falling from one's own height and being hit by a sharp object in 59% of cases, and orthopaedic injuries affecting the limbs in 96% of cases) are also consistent with Portuguese data [166] and the literature [116, 119-123] on global OA, which are substantially different from severe cases [76, 111, 112]. Being male significantly increases the risk of suffering an OA, imposing a reflexion about this fact [169]. This trend might partly be due to the nature and type of professional occupations traditionally performed by men, which frequently are in more high-risk and physically demanding areas, exposing them to more hazards at work [115]. Furthermore, even for the same occupation it has been found that the tasks, and subsequently the type of risks to which workers are exposed, differ for men and women, with more dangers being present for men [169-171]. Additionally, male-dominant work

environments often normalize and foster risk-taking cultures [172]. Research on this matter shows that men generally have lower risk perception than women, and therefore are more risk-seeking and tend to underestimate workplace hazards [173, 174], which might also contribute to the fact that men sustain more OA than women.

The fact that OAs occur mainly in young male workers highlights the importance of investing in professional rehabilitation and reintegration services to increase the chances of a successful return to work.

The workers' average schooling level was low and was below the current mandatory level of education in Portugal, which is 12 years. Lower educational levels have been associated with an increased risk of work absence [175, 176] and unsuccessful professional reintegration after OA [61, 76, 177, 178], but our results show other reality. In our study, despite the workers' low average schooling, most of them (80%) were already professionally active, perhaps because we are analysing a global sample of OAs in which most injuries and sequelae were minor, which is demonstrated, respectively, by the low injury severity level (45.5% non-existent, and 25.7% minor) and by the low mean PD rate ($\bar{X}$ =5.04%; SD=9.18), which was assigned to only 55% of the cases (Figure 5).

Our results are consistent with previous findings that younger age, being male, having low injury severity are associated with good professional outcomes. But regarding education and higher physical demands our results are not consistent with previous findings, since we observed good professional outcomes with participants with low education and more physically demanding tasks, as stated before. This result can also be related with Portuguese legislation as will be discussed below.

Professional status and PD (PIA results)

Portuguese legislation establishes that after an OA, employers have the responsibility to reintegrate injured workers in functions that are compatible with the functional limitations they may present because of the accident, considering their remaining capacities, education and age (Article 44 and Article 155(1), Law No. 98/2009, September 4th). Thus, professional reintegration can occur in workers' previous area of occupation (regarding their qualifications, experience and technical-professional competence) or in another area, which is more compatible with the workers' current capacity and functionality.

In our sample, all the participants were medically considered capable of returning to work (with or without PD), but only 80% were successfully professionally reintegrated, most of them in the same professional activity (Figure 4).

From the 20% who remained inactive (Figure 4), 12 were on sick leave assigned by their family doctor; seven became unemployed because of their professional contract type or by mutual agreement between employers and employees; and one retired, by personal choice, due to high age and low educational level, such that he or she considered it would restrain the odds of successful professional reconversion. Given our results (Table 10), we consider that depression symptoms and WSA difficulties are two important factors related to this professional outcome, as will be discussed in the next section. Nevertheless, we cannot ignore that complex interactions of factors, accordingly to other studies on this area, may underlie the non-return to work of these 20 injured workers:

Personal factors [9, 33, 75, 80, 179]: (1) imbalance between the effort required by professional rehabilitation and the worker's perceived gain, leading to a lack of involvement and motivation to do so, and to ask family doctors to prescribe sick leave; (2) self-perceived physical and psychological poor health; (3) difficulties in coping with the discomfort provoked from returning to the same professional context; (4) perceived incapacity to face the same work context with a new functional profile; (5) lack of perceived capacity to adapt to some job activities and demands; (6) perception of being a victim of injustice by peers or employers; and (7) high age, among others;

Work context factors [44, 74, 77, 89]: (1) difficulties in finding professional tasks compatible with the worker's new functionality, especially in smaller companies; (2) companies lack of interest in having employees with disabilities; (3) taking advantage of the event to terminate a professional contract that companies did not want to renew; (4) a lack of peer support and sometimes even harassment; and (5) a lack of awareness, from employers and sometimes from occupational doctors, about the importance of early professional rehabilitation to promote injured workers' health and recovery, among other factors;

Reparation system-related factors [46, 52-55] include the following: (1) financial reparation after OA is directly indexed to the PD rate, and therefore, injured workers may believe that a return to work contributes to decreased PD; (2) the expectation of increased gains from the OA may lead workers to exaggerate the severity of their clinical situation and/or be unwilling to collaborate in the professional rehabilitation

process; (3) a lack of information regarding the system may lead workers to search for information with peers and some professionals, which has the potential to be undeveloped and not clear about the importance of engaging in professional rehabilitation as soon as possible; (4) the complexity of the reparation system, which is often perceived by workers, employers, and health care providers as difficult to navigate, can lead to an additional source of stress that can affect the recovery process and professional rehabilitation; and (5) the perceived sense of injustice/unfairness related to service support and treatment can lead to resistance and litigation with the insurance company, among other factors. Although we conducted interviews, they were not designed to investigate the reasons why these workers did not return to work. Therefore, further analysis should be conducted to better understand which, if any, of the above-mentioned factors explains this result.

Ensuring effective professional reintegration following an OA is of utmost importance, not only for the injured worker's physical and psychological well-being but also for broader socioeconomic sustainability. We are facing a major challenge of workforce shrinking, mainly as a result of aging, but injuries and disabilities after OAs can aggravate the problem if injured workers are unable to return to work [180, 181]. The development and implementation of workplace health promotion strategies, along with OA prevention policies, are extremely important. Equally important are the development of strategies and interventions that can support professional reintegration after an OA, even for those with more difficulties to return to work. These efforts must ensure that both injured workers and workplace environments can effectively adapt to the functional and occupational performance changes resulting from OAs.

Psychological symptoms at the end of recovery and rehabilitation process

Psychological distress can occur after an OA [50, 57, 61, 151, 152]. Even if symptoms frequently disappear after the initial period of adaptation, there are cases in which they might persist over time and require specialized treatment aimed at decreasing their severity or preventing them from becoming permanent [182]. Even though, assessing psychological symptoms within the scope of a personal injury repair system, in which eventual financial compensation is at stake, may be a complex task, nevertheless its relevance is undeniable.

Previous studies have put in evidence the effects of depression, anxiety, emotional distress and pain, and perceived limitation to perform daily and professional activities on professional reintegration, and on the odds of having a PD [9, 48, 61, 153].

In our study, participants reported higher levels of psychological symptoms than expected (Table 9). In fact, this finding seems surprising if we consider the results related to injury and sequelae (PD) severity, which are not proportional. Thus, we admit, in considering the scope in which all this process took place (insurance company), that some participants might have been influenced by one or more of the factors noted before, especially personal factors. It is possible that some had expectations of added gains, even though they were informed, before study participation, that the data collected in this study had no relation with the insurance company process, as the PIA had already been completed. Regardless, it is still important to analyse the results related to each of the studied symptoms, while looking for other eventual reasons that could explain this result:

Emotional pain: In this study, we asked participants to evaluate their current and eventual emotional pain and suffering related to dealing with the consequences of the OA. Although the instrument used here may have limitations, since it was not a standardized measure, we found that 71.3% of the participants rated their emotional pain as equal to or greater than moderate. We hypothesize that some participants were still struggling with the acceptance of and adaptation to changes in their personal, social and professional lives and their functionality due to their OA. The literature indicates that adjusting to OA consequences is often a difficult process with the potential to trigger emotional suffering and distress [61, 183, 184], but we did not find studies that quantified its severity levels. Consequently, these results should alert physicians of the need to consider the possibility of their presence during the recovery period and professional rehabilitation.

WSA: WSA reflects workers' self-perceived capacity to perform in several life domains. Lower levels of self-perceived capacity have been established as predictors of poorer recovery and professional reintegration outcomes [39, 48, 80, 153]. Our results also revealed higher levels of WSA difficulty in both the professionally inactive group ($P<0.05$) and the group with assigned PD ($P<0.001$).

Anxiety: the rates found in this study were higher than anticipated (40.6%, above the cut-off point), since the literature refers to rates between 4% and 24% [38]. Although anxiety has been related to a lower probability of returning to work [9, 10,

34, 99, 100] and to factors that might increase professional disability (lower perceived self-efficacy, disruptions in treatment, lower productivity, among others), we did not find significant differences between groups in terms of this symptom. This result may be due to a multiplicity of facts that can overlap: some participants were, in fact, experiencing psychological worrying due to the impacts of the OA on several domains of their lives; others may be naturally stressed when submitted to a medical examination or some other kind of assessment; and others may be, in fact, concerned with questions related to financial reparation. Additionally, anxiety is very prevalent in the Portuguese population [185], although our study participants denied having previous diagnoses;

Depression: The incidence rates were above the cut-off point for 35.6% of the participants, which is consistent with the literature on OA, which established a prevalence ranging from 6%–42% [38]. Some authors consider that depression, as a psychological consequence of OA, may be due to a combination of injury financial burden, difficulties in pursuing compensation claims, long-term pain and suffering, and long recovery processes [155]. In our sample, depression was significantly greater in the professionally inactive group ($P<0.05$), which led us to consider that depressive symptoms strongly interfered with work capacity, as noted in the literature [9, 10, 99, 100]. Additionally, similar to anxiety, depression is a very prevalent disorder in Portugal [185], although our study participants denied having previous diagnoses of such mental health conditions.

Our sample was mainly of young man, which made us reflect about the fact that male injured workers might face unique barriers to adaptation and recovery after OA, largely due to internalized and societal definitions of masculinity, that can lead to experience OA sequelae as failures or being less capable [169]. This stigma can complicate professional rehabilitation and reintegration, since there can be a struggle with the emotional burden of feeling “broken” or “less of a man”, which can lead to increased emotional pain, anxiety, depression, or social isolation, that culturally can be more difficult to express and ask for help in men than in women. Paradoxically, while men can be discouraged from showing vulnerability, there is also the possibility that some may exaggerate their symptoms, perceiving secondary benefits such as extended leave or financial compensation. This duality reveals the complexity of masculine identities in relation to psychological well-being and calls for further research.

The most relevant goal is to keep track of the expression of these symptoms, helping professional reintegration and preventing them from becoming permanent.

Furthermore, early professional rehabilitation and reintegration are extremely important not only for fostering recovery but also for increasing perceived health status and capacity, which in turn acts as a protector against psychological problems, such as depression [9, 10, 99, 100].

These results suggest that all psychological symptoms should be identified early, interpreted and treated (when necessary) to help workers be emotionally more stable during the professional rehabilitation phase.

Interest in psychological symptom screening and follow-up after an OA

Professional reintegration after an OA constitutes a complex process, with several internal and external dimensions acting as positive and/or negative interferences. This process is tremendously important at the familial, social and financial levels for reducing costs related to work absences and medical care related to the secondary impacts of an OA. However, it is even more important at the personal level as a way of reducing workers' financial dependence and improving their physical and cognitive capacity, quality of life, well-being, social participation, and sense of utility. In fact, being professionally active can be considered a protective factor for physical and psychological health [9-12].

Psychological and psychiatric consequences may be a direct result of the trauma (primarily in traumatic brain injury cases) but also a secondary result from the experience of the OA (an adaptive reaction to a stressful/traumatic experience). The link between these outcomes and the event may be difficult to determine, especially in the last situation, which is the most frequent, because we are often addressing each person's subjectivity and sometimes previous mental health conditions, within the scope of an insurance company/financial reparation system. However, this possibility cannot be a reason to ignore the symptoms. Injured workers' psychological status should be assessed as early as possible and, if present, monitored and treated, preventing them from becoming permanent, avoiding litigation [35, 62], and empowering professional rehabilitation and reintegration processes [32, 53, 54, 59, 83]. It is also important that insurance company professionals are alert and use instruments that allow them to identify and distinguish victims who indeed need psychological treatment, from those who are, consciously or unconsciously, searching for financial compensation benefits, not only during recovery and rehabilitation but also during the professional reintegration phase. All health professionals involved in professional

rehabilitation and reintegration should keep in mind that for those to whom psychological symptoms and disorders arise after OA, treatment has to be provided at any stage of the process.

Therefore, it is very important to be alert to psychological symptoms that may arise after the OA, screen them, and, if needed, offer treatment to help injured workers cope with the situation, reducing their probability of experiencing long-lasting disability. It is also important to analyse whether there is a gap in the practice of systematic, measurable and standardized assessment of the effects of psychological symptoms on OA consequences.

Limitations of the study and further studies

The main limitations of this study are as follows: (1) the methodological characteristics of a cross-sectional study design; (2) the use of a convenience sample; (3) the sample dimension; (4) the use of psychological measures at only one timepoint, which prevented us from better understanding participants' psychological status evolution at different stages of the recovery process; (5) the use of a non-standardized measure of emotional pain that does not capture the full complexity of emotional pain, such as its duration and intensity over time, and does not have standardized norms; (6) the fact that we did not collect information related to socioeconomic status, medication, job demands, and social support, which could have helped us to better understand our results.

To comprehend the impact of psychological symptoms during professional rehabilitation and reintegration, further studies with larger samples should be conducted that consider (1) psychological dimensions at different stages of the recovery process and their effects on PD and professional reintegration; (2) early assessment of psychological status and analysis of its impact on professional outcomes; (3) the use of standardized measures of emotional pain; (4) the use of malingering instruments to mitigate possible bias; and (5) exploring if there are significant differences between men and women regarding psychological symptoms.

Conclusions

Our study results show the following: (1) most of the participants reported psychological symptoms at the time of the PIA at an insurance company at a level equal to or above moderate: emotional pain (71.3%); difficulties at WSA (61.4%); anxiety (40.6%); and depression (35.6%). (2) The professionally inactive group (20%) presented higher levels of all these symptoms, with significant differences in WSA difficulties and depression ($P<0.05$). (3) The assigned PD group (55%) presented higher levels of all these symptoms, with significant differences in WSA difficulty ($P<0.001$). (4) WSA was revealed to be a good predictor of both professional status and PD attribution ($OR=1.069$; $95\%CI=1.03-1.13$; $P<0.05$).

Even if only WSA acted as a predictor of professional reintegration and PD, the higher levels of all the psychological measures in the inactive and PD groups may act as an alert sign. We believe that screening for psychological symptoms after OA should always be performed during the recovery process, regardless of their structural or reactive nature. Their treatment and monitoring may be very useful for supporting an early professional rehabilitation process and reducing negative professional outcomes, ensuring better reintegration. This approach will be very important not only for promoting workers' health and quality of life by reducing the odds of long-term psychological symptoms, but also for familial, social and financial reasons.

3. Quality of life post-occupational accident. A reintegration and forensic approach

The work described in this Chapter was submitted to Frensic Sciences on 14.01.2026., and is authored by: Isabel Almeida^{1,2,*}, Pedro M. Teixeira³, José Manuel Teixeira⁴ and Teresa Magalhães^{1,5-7}.

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Abstract:

Health-related quality of life perception (HRQoL) reflects the impact of individuals' health conditions on their physical, psychological, and social well-being, and can be compromised after an accident. The general aim of this study was to analyse the effect of occupational accident (OA) outcomes on injured workers' HRQoL. We conducted a cross-sectional study, using a convenience sample of 101 participants at the end of their recovery and professional reintegration (PR) process. They were submitted to a personal injury assessment (PIA) conducted by medico-legal specialists, and data related to injury severity (IS), permanent professional disability (PD) and PR were collected from the respective forensic reports. Subsequently, they underwent a psychological interview and fulfilled self-report questionnaires to measure HRQoL (SF-36) and resilience (RSA).

For each variable two groups were defined. Analyses included descriptive statistics, correlations, group comparisons, and multiple linear regression analyses. Injured workers reported lower HRQoL than Portuguese norms across most domains. HRQoL

scores were positively associated with resilience and PR, and negatively associated with IS and PD. In multivariable models, IS, and RSA emerged as significant independent predictors of the physical–social HRQoL component. These findings highlight the importance of a biopsychosocial and multidisciplinary approach to OA victims’ professional reintegration, integrating physical treatment, psychological support with resilience-building, and work rehabilitation, before medical discharge and PIA.

Keywords: Health related quality of life; Occupational accident; Professional outcomes; Professional rehabilitation; Professional reintegration; Medico-legal evaluation; Personal injury assessment.

Introduction

Health-related quality of life (HRQoL) measures has been widely used to assess how health conditions impact individuals’ well-being perception across multiple domains of their life (physical, psychological, and social) [91]. Individuals with traumatic injuries consistently report lower quality of life than non-injured populations, even long years after injury [92, 93]. HRQoL is a multidimensional concept and may be influenced, among others, by personal perceptions, beliefs, life experiences, expectations, and personality [186, 187].

Back in 1998, Magalhães referred to this mechanism regarding road traffic accidents, which is described in Figure 6 [73]. It highlights the influence of personal and environmental factors on the final personal injury and quality of life (this, in addition to the effect of experiencing the trauma, the resulting injuries, and the treatments implemented, including rehabilitation). It also clearly indicates that the final/permanent personal injury and the quality of life perceived by the victim mutually influence each other.

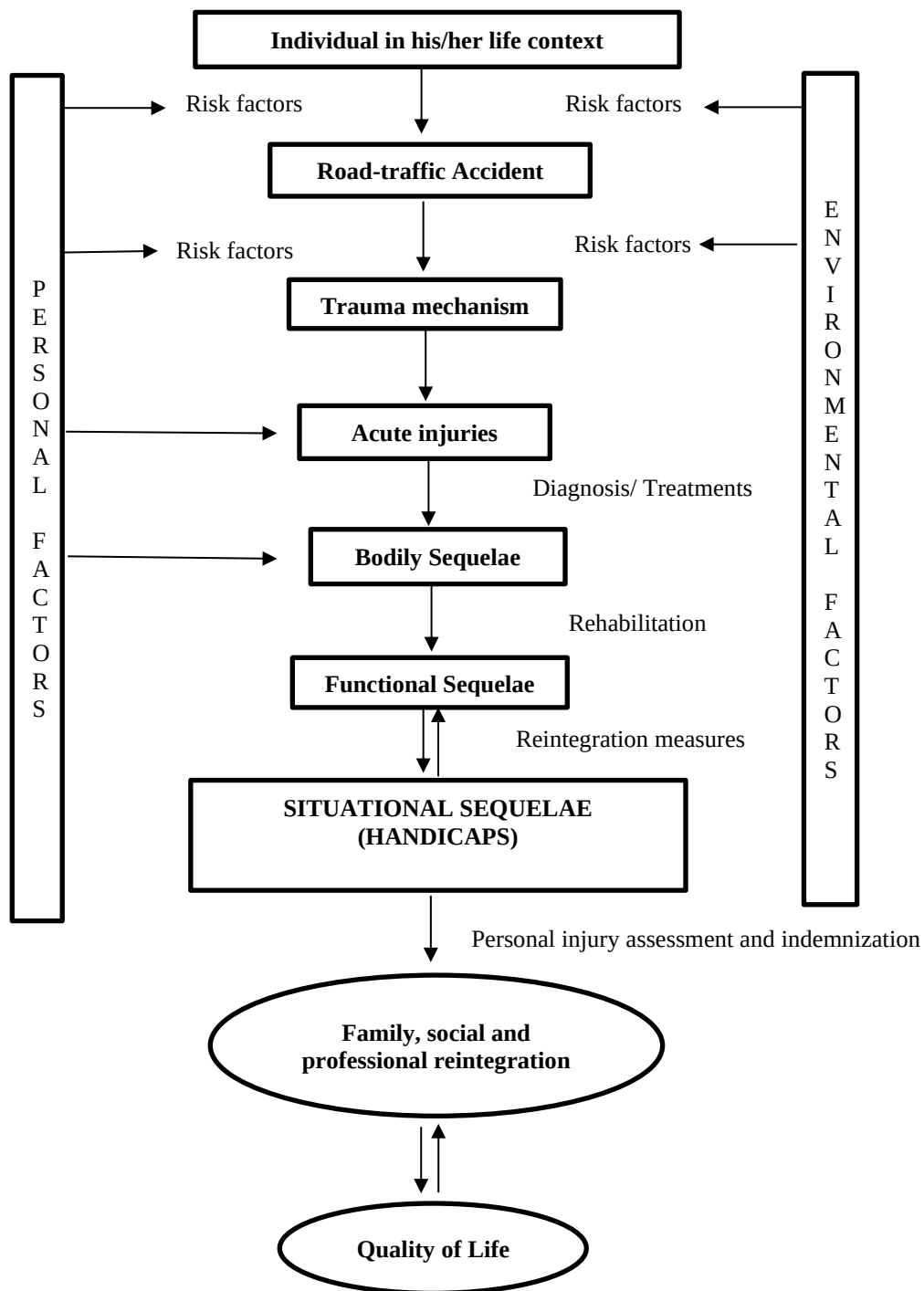


Figure 6. Diagram describing evolution process of personal outcomes after an accident, including reintegration and HRQoL (authors free translation)

A similar model was presented by the World Health Organization (WHO) through the International Classification of Functioning, Disability and Health (ICF) [148, 188], which offered a robust framework that is useful to conceptualize HRQoL. While HRQoL instruments aim to capture individuals' perceptions, the ICF offered a

standardized taxonomy to describe functioning across body functions and structures, activities and participation, as well as personal and environmental factors. Systematic linking rules between ICF categories and HRQoL questionnaire items was made through Cieza et al. [189, 190] methodological work.

An occupational accident (OA) may directly or indirectly have a negative impact on HRQoL, due to physical, psychological, socioeconomic, familial, and professional outcomes [5-8, 94, 95, 191-193], which can be temporary or permanent. Available evidence revealed, for example, an inverse relation between HRQoL and workers' disability [192].

Thus, HRQoL measure can provide useful information to better understand some personal outcomes after an OA, such as professional reintegration (PR) or permanent professional disability (PD). Moreover, HRQoL, together with personal factors (as demographic, resilience capacity, clinical and socioeconomics) can help to predict return to work, income, and employment stability - workers who successfully were professional reintegrated report higher HRQoL across all its domains [96, 97, 194, 195]. However, to our knowledge, there are few studies addressing these relationships [96, 196-198]. Specifically, regarding resilience, studies results are inconsistent [199, 200], but some have shown that higher levels of resilience have been associated with better HRQoL [198, 201], supporting its role as a personal resource that may help individuals to cope more effectively better with OA outcomes, and enhance their capacity to engage in professional rehabilitation efforts.

The general aim of this study is to analyse the effect of some OA outcomes on injured workers' HRQoL perception. The specific objectives are to: (a) describe injured workers' HRQoL, in all its domains, and compare it with non-injured Portuguese population scores; (b) analyse the relationships between HRQoL and some personal dimensions (sex, age, marital status, and resilience); (c) analyse the relationship between HRQoL and acute injury severity (IS); (d) analyse the relationship between HRQoL, PD, and PR.

Material and methods

Participants

A global sample of 101 workers victims of OA, was recruited at the medical services of a Portuguese insurance company. This was because in Portugal all injured workers are assisted by these companies for treatment and professional

rehabilitation/reintegration, as well as for medico-legal personal injury assessment (PIA) at discharge (Law No. 98/2009, September 4th).

The defined criteria for participants selection were: (a) having sustained an OA, irrespective of sex, age, profession, and injury typology, severity and location; (b) being at the end of the OA recovery and professional rehabilitation/reintegration process, which means having a final PIA by a medico-legal expert, and having the respective report available for consultation; (c) capacity to give consent for participation and to respond to a short sociodemographic interview and to self-administered questionnaires. Having health comorbidities and pathologies, occurred before or after the OA, that could potentially confound responses was the only defined exclusion criteria (i.e. previous morbidities such as stroke, degenerative diseases, diagnoses of anxious and/or depressive disorders, previous accidents resulting in major sequelae that were obtained from personal antecedents' description - pathological and traumatic – of PIA report). The mean time from OA to final PIA, when data for this study was collected, was 201.5 days (SD=121.2; range: 51–789).

Methods

We conducted a cross-sectional study over a six-month period, using a convenience sample. The study protocol was approved by Ethics Committee of the Faculty of Medicine of Porto University (date 19.07.2019/ No. 232/19). Written informed consent was provided by those who fulfilled study criteria, prior to data collection. Explicit information was given that the study was entirely independent of the insurance company's process. Two studies were conducted using this sample, the first being already published [63].

Variables and instruments used in this study are described below:

a) Health-related quality of life

HRQoL was measured using the Portuguese version of the *36-Item Short Form Survey* (SF-36) [202, 203]. This self-administrated instrument comprises 36 itens covering 8 domains: (a) *Physical functioning* (10 items); (b) *Role-physical* (4 items); (c) *Bodily pain* (2 items); (d) *General health* (6 items); (e) *Vitality* (4 items); (f) *Social functioning* (2 items); (g) *Role-emotional* (3 items); (h) *Mental health* (5 items). These 8 domains can be aggregated into 2 summary measures: *Physical composite scale*, and *Mental composite scale*. Domains scores range from 0 to 100, with higher scores indicating

better HRQoL. The Portuguese version of the SF-36 has shown adequate reliability, construct and clinical validity [202, 203], and provides Portuguese population norms [204].

b) Personal dimensions

Participants' sociodemographic characteristics were gathered through a brief interview. The dimensions analysed were sex, age (at the time of the OA), marital status, and profession. With exception of profession, which was only used for sample description purposes, two groups were created for each personal dimension: (a) sex (female vs male); (b) age (<50 years vs ≥ 50 years) – this criteria was based on No. 5, Alinea a) of General Instructions of Annex 1 of the Decree-Law 352/2007, that establishes the age of 50 years or older as the age when PD may be increased by using a multiplying factor; and (c) marital status (living in communion vs living alone).

Resilience was included as a personal dimension given its relevance to HRQoL outcomes. For this study purpose we used the following definition of resilience: individual's capacity to maintain their psychological and physical well-being when facing adversity [205-207]. It was assessed through the Portuguese version of the *Resilience Scale for Adults* (RSA) [208], a 33-item self-report measure that evaluates 6 protective domains: (1) *Perception of self* (6 items) - individual's confidence in their ability to manage or cope with adverse life events; (2) *Planned future* (4 items) - whether individuals feels hopeful about they future and have a preference for make realistic plans and set goals that can be achieved; (3) *Social competence* (6 items) - individual's ability to engage socially, feel at ease in social settings, and their flexibility in social interactions; (4) *Family cohesion* (6 items) - shared family values, views of the future, family loyalty, and mutual appreciation; (5) *Social resources* (7 items) – the degree in which the individual has resources outside the family that may provide encouragement and assistance if needed; (6) *Structured style* (4 items) - individual's preference for establishing routines, planning ahead, and approaching tasks in an organized manner [209, 210]. Furthermore, a RSA total score can be calculated using all items. It uses a 7-point semantic differential scale with items having a positive and a negative attribute at each end. RSA subscale and total scores are derived by reverse-coding negatively keyed items and calculating mean scores across relevant items, with higher values representing greater resilience. This measure has shown good psychometric properties both at the original and the Portuguese version [208, 211], but

no Portuguese normative data were provided. Several studies [209, 210, 212, 213] have consistently reported mean RSA scores around 5.3-5.5, on the 1-7 scale, indicating that a score of 5 approximates the lower bound of average resilience. We consider that this provided a theoretically and empirically justified criterion to differentiate individuals with lower versus higher resilience resources. Based on these findings [209, 210, 212, 213] we established a cut-off point of ≤ 5 for RSA total score to create two groups: low vs adequate-high resilience.

c) Accident characterization

OA mechanisms and resulting injuries were obtained through the PIA report, and used for sample description.

d) Acute injury severity

IS was assessed using the Injury Severity Score (ISS) [214]. In this scale, each injury is graded from 1 (minor) to 6 (maximal - unsurvivable), according to its severity. The ISS is calculated based on the three most severe injuries across different body regions [109, 110]. ISS was estimated through forensic reports: 0 (non-existent), 1-8 (minor or moderate), 9-15 (serious), 16-24 (severe), and 25-75 (critical). For this study, two IS groups were considered: none-moderate (0-8) vs serious-critical (9-75).

e) Permanent professional disability

In Portugal PD is defined as the percentage of functional impairment affecting work capacity and earning potential, resulting from OA sequelae, in accordance with Decree-Law 352/2007 [66, 74]. PD information was obtained from PIA report. Firstly, PD percentage was considered according to the following scale [73]: (1) 0-5 (non-existent or minor); (2) 6-15 (moderate); (3) 16-40 (serious); (4) 41-70 (severe); (5) >70 (critical). Consequently, for the current study purposes two PD groups were defined: none-moderate (0-15) vs serious-critical (≥ 16). It was verified that the majority of the workers ($n=92$; 91.1%) was assigned within the first two group (PD 0-15%), which constrains further statistical analysis. Furthermore the maximum rate of PD assigned was 43.3%. Thus, we assumed as groups: none-minor (0-5) vs moderate-severe (6-70).

e) Professional reintegration

For this variable analyses we considered the professional status at the time of the end of recovery and professional rehabilitation/reintegration process, described at PIA report. Two PR groups were created: reintegrated vs non-reintegrated.

All self-reported measures used revealed very good internal consistency with our sample (SF-36 $\alpha=0.92$; RSA $\alpha=0.86$).

Statistical analyses

Sample characteristics, including personal variables (sex, age, marital status, profession, and resilience), OA mechanisms and resulting injury location, IS, PD rate, PR, and HRQoL scores were analysed through descriptive statistics.

After ensuring the necessary assumptions of normality, all HRQoL domains were compared with the Portuguese norms using *independent sample t-test*. Effect size differences for each comparison were calculated using *Cohen's d*.

Spearman and *Pearson correlations* were conducted, accordingly to variable characteristics, to explore correlations between HRQoL and sex, age, marital status, resilience domains, IS, PD and PR. Given the exploratory nature of this analyses, findings should be interpreted as hypothesis-generating.

HRQoL scores were compared between the groups created for each variable (with exception of profession), as described above. For these analyses, appropriate group comparison tests were applied, accordingly to prior verification of normality and homogeneity of variances assumptions. Normality was assessed using the *Shapiro-Wilk* test, which is recommended for small to moderate sample sizes. Homogeneity of variances was assessed using *Levene's test*. Variables that met both assumptions ($p>0.05$ in Shapiro-Wilk for both groups; $p>0.05$ in Levene's test) were analysed using the *independent-samples t-tests*. For variables that violated the assumption of normality ($p<0.05$ in at least one group), the *Mann-Whitney U test* was used as a non-parametric alternative.

Multiple linear regression analyses were conducted to investigate whether age, sex, marital status, resilience (RSA total), IS, PD, PR were predictors of HRQoL. To reduce dimensionality and simplify interpretation, principal component analyses (PCA) was performed on the HRQoL dimensions, generating two factor scores: a) Factor 1 - physical and social health-related dimensions, b) Factor 2 - mental and emotional

health-related dimensions. Separate multiple linear regression models were conducted, considering each PCA factor score as the dependent variable. The enter method was used, and model assumptions were confirmed, as well as multicollinearity, which was evaluated via tolerance and variance fluctuation (VIF).

All statistical analyses were performed using SPSS for windows Version 29.0 (IBM Corporation, Armonk, NY, USA). Statistical significance was set at a *p*-value of less than 0.05.

Results

Variables description

Participants mean age was 44.7 years (SD=11.2; range 18-69), and most were male (*n*=64; 83.2%) and living in communion (*n*=69; 68.3%). At the time of the OA, the most common professional categories were general services and trade personnel (28.7%), construction workers (24.8%), and plant and machinery operators (19.8%). Resilience scores are presented in Table 12.

Table 12. Resilience domains scores (Mean and Standard Deviation) (*n*=101)

	$\bar{X}$ (SD)
Perception of self	4.4 (1.1)
Planned future	4.6 (1.3)
Social competence	4.5 (0.9)
Family cohesion	4.7 (1.1)
Social resources	4.7 (1.2)
Structured style	4.1 (0.9)
RSA total	4.5 (0.8)

The most frequent accident mechanism was effort-related trauma (*n*=24; 23.8%), followed by falls from own height (*n*=21; 20.8%), and injuries caused by sharp objects (*n*=14; 13.9%). Crush injuries accounted for 12 OA (11.8%), while both falls from height and road traffic accidents occurring during commuting (*in itinere*) were each reported in 11 cases (10.9%). Less frequent mechanisms included injuries caused by blunt objects (*n*=6; 5.9%), burns (*n*=1; 1.0%), and dog bites (*n*=1; 1.0%).

Injury location was collected considering for each participant all reported injuries. The upper limbs were the most affected region ($n=51$; 50.5%), followed by the lower limbs ($n=45$; 45.5%). Spinal (raquis/spinal cord) injuries were reported in 14 participants (13.9%). Injuries involving the face and/or neck occurred in 4 (4.3%), while cranial/brain injuries and chest and/or abdominal injuries were each observed in 3 participants (3.0%).

Acute injury severity was classified as none-moderate in 72 participants (71.3%), and serious-critical in 29 (28.7%).

Regarding PD the mean rate was 5.0% (SD=9.2; range 0-43.3%). Most of the workers ($n=71$; 70.3%) were assigned with a PD between 0-5% (none-minor), which means that they could, at least, perform essential job tasks, even if with additional effort or technical adaptations. Just 4 workers (0.04%) required complete professional reconversion. Concerning PR, 81 participants (80.2%) were professionally reintegrated: 72 (71.3%) returned to their previous occupation, and 9 (8.9%) transitioned to different roles, including 5 with job adaptations and 4 with full professional reconversions. Non-reintegration affected 20 participants (19.8%), comprising 12 (11.9%) on general physician assigned sick leave, 7 (6.9%) unemployed due to the OA, and 1 (1.0%) retired.

HRQoL

HQRoL scores and its comparison with Portuguese population norms are shown in Table 13. Injured workers showed lower scores of HRQoL in most of the domains, with observed effect sizes that ranged from medium to large (Table 13). Exceptions were found on *General health* and *Physical composite scale* domains, where no significant differences were observed, and on the *Mental composite scale* were injured workers showed significantly higher scores, with a small effect size, than general population norms [204].

Table 13. Comparison of HRQoL scores between global study sample and Portuguese population norms ($n=101$)

	HRQoL (SF-36)					
	<i>Global sample</i>	<i>Portuguese norms</i>				
	($n=101$)	($n=1500$)				
	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$t(100)$	p	Cohen's d	Interpretation
PF	63.4 (23.8)	80.2 (24.7)	-7.1	< 0.001**	-0.70	↓ Significant, medium effect
RP	45.3 (32.2)	78.4 (25.6)	-10.4	< 0.001**	-1.03	↓ Significant, large effect
BP	40.1 (25.1)	71.4 (24.3)	-12.5	< 0.001**	-1.25	↓ Significant, large effect
GH	60.8 (18.9)	59.5 (15.4)	0.7	0.51	0.07	No significant difference
VT	47.9 (20.8)	63.0 (23.1)	-7.3	< 0.001**	-0.73	↓ Significant, medium effect
SF	65.8 (30.2)	79.9 (23.4)	-4.7	< 0.001**	-0.47	↓ Significant, medium effect
RE	59.4 (33.5)	79.8 (24.7)	-6.1	< 0.001**	-0.61	↓ Significant, medium effect
MH	52.9 (21.8)	72.9 (23.3)	-9.3	< 0.001**	-0.92	↓ Significant, large effect
PCS	52.4 (16.8)	50.0 (10.0)	1.4	0.15	0.14	No significant difference
MCS	56.5 (19.5)	50.0 (10.0)	3.3	0.001**	0.33	↑ Significant, small effect

PF = Physical Functioning, RP = Role-Physical, BP = Bodily Pain, GH = General Health, VT = Vitality, SF = Social Functioning, RE = Role-Emotional, MH = Mental Health, PCS = Physical Component Summary, MCS = Mental Component Summary. * $p < 0.05$; ** $p < 0.01$. ↑ = higher in sample than normative mean; ↓ = lower. Effect size interpretation: small ($|d| \approx 0.2$), medium (≈ 0.5), large (≥ 0.8).

Correlations

Correlations between HRQoL domains and variables of interest are shown in Table 14.

Correlation analyses revealed coherent patterns between HRQoL domains and variables of interest (Table 14). Resilience—particularly the *Perception of Self*—was positively associated with multiple HRQoL domains ($\rho = 0.20$ – 0.37 , $p \leq 0.03$), suggesting that psychological protective factors may buffer the functional and emotional impact of occupational injury. Conversely, IS and PD correlated negatively with physical and social HRQoL components ($\rho = -0.20$ to -0.32 , $p \leq 0.04$), underscoring the enduring influence of objective sequelae on subjective well-being. Professional reintegration showed modest but significant associations with *Bodily Pain* and *Social Functioning*, aligning with prior evidence that work participation supports perceived health.

Table 14. Correlations between HRQoL and, sex, age marital status, resilience, IS, PD and PR ($n=101$)

	HRQoL (SF-36)									
	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
	$\rho(p)$	$\rho(p)$	$\rho(p)$	$\rho(p)$	$\rho(p)$	$\rho(p)$	$\rho(p)$	$\rho(p)$	$\rho(p)$	$\rho(p)$
Sex	-0.05(0.59)	0.20(0.04)*	-0.19(0.04)*	-0.10(0.30)	-0.15(0.13)	-0.15 (0.13)	-0.01 (0.91)	-0.09(0.39)	-0.03(0.79)	-0.12(0.22)
Age	-0.12(0.25)	0.12(0.22)	-0.04(0.67)	-0.27(0.007)**	-0.15(0.13)	-0.09(0.39)	0.18(0.07)	-0.18(0.06)	-0.07(0.51)	-0.06(0.58)
Marital status	0.17(0.09)	0.03(0.79)	0.21(0.04)*	-0.07(0.51)	0.07(0.50)	0.03(0.77)	0.18(0.08)	-0.02(0.84)	0.06(0.55)	0.09(0.35)
RESILIENCE										
Perception of self	0.31(0.002)*	-0.03(0.80)	0.22(0.03)*	0.23(0.02)*	0.26(0.008)*	0.37(<0.001)**	-0.10(0.32)	0.35(<0.001)**	0.16(0.10)	0.28(0.004)*
Planned future	0.21(0.03)*	-0.04(0.72)	0.13(0.19)	0.35(<0.001)**	0.32(0.001)*	0.36(<0.001)**	-0.07(0.51)	0.13(0.19)	0.01(0.92)	0.05(0.66)
Social competence	0.06(0.55)	0.05(0.632)	-0.03(0.78)	-0.10(0.30)	0.05(0.65)	0.15(0.14)	-0.07(0.51)	0.13(0.19)	0.01(0.92)	0.05(0.66)
Family cohesion	0.23(0.02)*	0.09(0.34)	0.18(0.14)	0.09(0.39)	0.17(0.09)	0.33(<0.001)**	-0.11(0.26)	0.25(0.01)*	0.19(0.06)	0.20(0.04)*
Social resources	0.24(0.02)*	0.04(0.67)	0.09(0.34)	0.09(0.38)	0.13(0.21)	0.29(0.003)*	-0.13(0.20)	0.25(0.01)*	0.18(0.08)	0.15(0.14)
Structured style	-0.07(0.47)	-0.08(0.41)	-0.08(0.44)	0.05(0.63)	-0.04(0.72)	0.03(0.75)	-0.12(0.24)	-0.10(0.92)	-0.12(0.24)	-0.07(0.47)
RSA total	0.25(0.01)*	0.03(0.79)	0.10(0.31)	0.15(0.14)	0.18(0.08)	0.34(<0.001)**	-0.14(0.18)	0.30(0.002)*	0.18(0.08)	0.19(0.06)
IS (ISS)	-0.18(0.07)	-0.07(0.46)	-0.14(0.16)	-0.15(0.15)	-0.21(0.04)*	-0.25(0.01)*	-0.15(0.14)	-0.16(0.12)	-0.21(0.04)*	-0.25(0.01)*
PD	-0.32(0.001)*	-0.14(0.17)	-0.17(0.09)	-0.21(0.03)*	0.23(0.02)*	-0.23(0.02)*	-0.08(0.43)	-0.14(0.15)	-0.32(<0.001)**	-0.20(0.04)*
PR	-0.12(0.24)	-0.04(0.67)	-0.26(0.01)*	-0.01(0.89)	-0.16(0.12)	-0.23(0.02)*	0.10(0.31)	-0.14(0.18)	-0.11(0.29)	-0.15(0.14)

PF = Physical Functioning, RP = Role-Physical, BP = Bodily Pain, GH = General Health, VT = Vitality, SF = Social Functioning, RE = Role-Emotional, MH = Mental Health, PCS = Physical Component Summary, MCS = Mental Component Summary. * $p < 0.05$; ** $p < 0.01$;

Comparison of HRQOL scores between groups

The comparisons between HRQoL scores and variable of interest groups are shown in Table 15.

Group comparisons corroborated the correlational findings. Participants with adequate–high resilience reported significantly higher scores across *Physical*, *General health*, *Vitality*, *Social*, and *Mental* HRQoL domains, reinforcing the protective role of psychological resources. Conversely, those with serious–critical IS or moderate–severe PD demonstrated poorer outcomes in *General Health*, *Vitality*, and *Social Functioning*. Notably, non-reintegrated workers reported greater *Bodily Pain* and reduced *Social Participation*, suggesting that functional recovery and workplace re-engagement may mutually reinforce perceived quality of life. Due to the marked imbalance in group sizes (male $n=84$; female $n=17$), sex-based comparisons should be interpreted with caution and considered exploratory.

Table 15. Comparison of HRQoL scores between sex, age, marital status, resilience, IS, PD, and PR groups ($n=101$)

		HRQoL (SF-36)									
		PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Sex	Male ($n=64$) - $\bar{X}$ (SD)	63.9 (23.9)	42.6 (31.9)	41.9 (24.8)	61.9 (17.9)	49.3 (20.5)	68.0 (29.3)	59.5 (33.9)	53.7 (21.5)	52.6 (16.8)	57.6 (19.1)
	Female ($n=17$) - $\bar{X}$ (SD)	60.6 (24.1)	58.8 (30.5)	31.4 (25.5)	54.9 (23.1)	40.8 (21.3)	55.1 (33.1)	58.8 (32.3)	48.7 (23.6)	51.4 (17.3)	50.9 (21.3)
	t/U	654.5	929.0	498.0	1.4 (99)	548.0	549.0	701.5	618.0	0.26 (99)	1.303 (99)
	p	0.588	0.046*	0.048*	0.082	0.131	0.128	0.906	0.382	0.398	0.098
Age	< 50 years ($n=66$) - $\bar{X}$ (SD)	66.2 (23.3)	45.1 (33.5)	40.2 (24.8)	64.3 (17.2)	50.9 (20.3)	67.2 (30.0)	58.6 (34.1)	55.6 (20.2)	53.9 (16.1)	58.1 (19.2)
	≥ 50 years ($n=35$) - $\bar{X}$ (SD)	58.1 (24.2)	45.7 (30.0)	39.8 (26.1)	54.1 (20.6)	42.1 (20.9)	63.2 (30.8)	60.9 (32.8)	47.8 (23.9)	49.4 (17.9)	53.5 (20.1)
	t/U	925.5	1185.0	1130.0	2.65 (99)	866.5	1058.0	1197.5	904.0	1.29 (99)	1.12 (99)
	p	0.100	0.826	0.857	0.005*	0.039*	0.428	0.752	0.073	0.100	0.133
Marital status	Living in communion ($n=69$) - $\bar{X}$ (SD)	61.2 (23.2)	46.7 (28.7)	40.3 (22.2)	58.0 (18.8)	47.4 (19.8)	66.7 (29.3)	58.5 (34.0)	52.3 (20.8)	51.6 (14.8)	56.2 (19.7)
	Living alone ($n=32$) - $\bar{X}$ (SD)	68.1 (24.8)	42.2 (38.9)	39.7 (30.9)	66.8 (18.1)	48.9 (23.1)	64.1 (32.5)	61.5 (32.9)	54.0 (24.2)	54.2 (20.6)	57.1 (19.5)
	t/U	1310.0	997.5	998.5	1383.5	116.0	1066.0	1160.5	1176.0	-0.65 (99)	-0.21
	p	0.132	0.426	0.438	0.041*	0.682	0.778	0.667	0.598	0.058	0.933
Resilience (RSA total)	Low ($n=75$) - $\bar{X}$ (SD)	60.3 (24.6)	46.7 (32.9)	38.0 (25.3)	58.8 (19.7)	44.5 (20.8)	59.3 (29.3)	61.3 (31.5)	48.2 (21.3)	50.9 (17.7)	53.3 (18.6)
	Adequate-high ($n=26$) - $\bar{X}$ (SD)	72.5 (19.1)	41.3 (29.9)	46.0 (23.9)	66.4 (15.8)	57.7 (17.8)	84.6 (24.8)	53.8 (38.9)	66.5 (17.4)	56.6 (13.1)	65.6 (19.4)
	t/U	1269.5	882.5	1177.5	-1.792 (99)	1326.5	1485.0	876.0	1445.5	-1.485 (99)	-2.875 (99)
	p	0.022*	0.462	0.113	0.038*	0.006*	<0.001**	0.423	<0.001**	0.070	0.002*
IS (ISS)	None-moderate ($n=72$) - $\bar{X}$ (SD)	66.3 (22.5)	46.9 (33.3)	41.4 (23.9)	62.7 (17.7)	50.6 (20.7)	71.2 (27.0)	62.5 (33.1)	55.2 (20.9)	54.3 (15.9)	59.8 (17.4)
	Serious critical ($n=29$) - $\bar{X}$ (SD)	56.2 (25.8)	41.4 (29.3)	36.8 (27.9)	55.9 (21.4)	41.0 (19.7)	52.6 (33.9)	51.7 (34.0)	47.2 (23.2)	47.6 (18.3)	48.1 (22.3)
	t/U	805.0	947.5	856.5	1.65 (99)	771.0	714.0	855.5	836.5	0.629 (99)	2.828 (99)
	p	0.072	0.458	0.156	0.05*	0.040*	0.012*	0.140	0.118	0.034*	0.003*
PD	None-minor ($n=71$) - $\bar{X}$ (SD)	66.6 (22.5)	46.9 (33.5)	41.5 (24.1)	62.9 (17.7)	50.6 (20.8)	70.9 (27.1)	61.9 (32.9)	55.2 (21.1)	54.5 (15.9)	59.7 (17.4)
	Moderate-severe ($n=30$) - $\bar{X}$ (SD)	55.8 (25.4)	41.7 (28.9)	36.7 (27.5)	55.6 (21.1)	41.5 (19.6)	53.8 (33.9)	53.3 (34.6)	47.5 (22.9)	47.4 (18.0)	49.0 (22.4)
	t/U	799.5	947.5	870.0	1.8 (99)	801.0	753.0	912.5	861.0	1.9 (99)	2.6 (99)
	p	0.045*	0.491	0.144	0.036*	0.049*	0.019*	0.230	0.129	0.027*	0.006*
PR	Reintegrated ($n=81$) - $\bar{X}$ (SD)	65.1 (22.7)	45.9 (31.2)	42.0 (23.3)	61.5 (17.2)	49.6 (20.9)	69.3 (29.3)	57.6 (34.2)	54.3 (21.7)	53.6 (15.7)	57.7 (19.6)
	Non-reintegrated ($n=20$) - $\bar{X}$ (SD)	56.8 (27.5)	42.5 (36.4)	32.4 (30.9)	57.9 (25.2)	41.0 (19.6)	51.9 (30.7)	66.7 (30.6)	47.0 (21.9)	47.4 (20.5)	51.6 (18.7)
t/U		671.5	760.0	513.0	0.744 (99)	626.0	547.5	924.5	651.0	1.498 (99)	1.247 (99)

PF = Physical Functioning, RP = Role-Physical, BP = Bodily Pain, GH = General Health, VT = Vitality, SF = Social Functioning, RE = Role-Emotional, MH = Mental Health, PCS = Physical Component Summary, MCS = Mental Component Summary. * $p < 0.05$; ** $p < 0.01$;

Regression models

The regression model predicting Factor 1 (physical and social components) was significant [$F(7, 93) = 4.04$, $p < 0.001$], explaining 23.3% of the variance ($R^2 = 0.233$, adjusted $R^2 = 0.175$). Significant predictors were: IS ($\beta = -0.515$, $p = 0.006$), indicating higher injury severity was associated with lower physical/social HRQoL; RSA total ($\beta = 0.199$, $p = 0.043$) suggesting higher resilience was associated with higher scores on this factor; and PD ($\beta = 0.384$, $p = 0.040$), that showed a unexpected positive association. Evidence of multicollinearity between IS and PD, reflected by VIF values (>4), was found, suggesting there was overlap between these predictors (Table 16). Despite the evidence of multicollinearity between these variables, both predictors were retained in the model because they represent conceptually distinct dimensions relevant to the study aims. Nevertheless, the high correlation between these variables may have affected coefficient stability and contributed to the unexpected direction of the PD coefficient. Consequently, findings regarding the independent contribution of PD

should be interpreted cautiously. The other variables (age, sex, marital status, PR) were not statistically significant.

The regression model for Factor 2 (mental and emotional components) was not statistically significant [$F(7, 93) = 1.73$, $p = 0.111$], explaining only 11.5% of the variance ($R^2 = 0.115$, adjusted $R^2 = 0.049$). Although no statistical significance was found, marital status ($\beta = 0.171$, $p = 0.098$) and age ($\beta = 0.190$, $p = 0.068$) showed trends suggesting potential associations with this HRQoL factor. As in the previous model, multicollinearity diagnostics indicated overlap between IS and PD, with elevated VIF values (>4), suggesting potential instability in coefficient estimation. Results are presented in Table 16.

Table 16. Multiple Linear Regression Models Predicting HRQoL Factor Scores

Predictor	Factor 1			Factor 2		
	β (95% CI)	p	VIF	β (95% CI)	p	VIF
Sex	-0.136(-0.867, 0.143)	0.16	1.11	0.127(-0.203, 0.881)	0.22	1.11
Age	-0.112(-0.027, 0.007)	0.25	1.11	0.190 (-0.001, 0.036)	0.07	1.11
Marital status	0.113(-0.112, 0.445)	0.24	1.10	0.171 (-0.047, 0.551)	0.09	1.09
RSA total	0.199 (0.000, 0.015)	0.04	1.14	-0.056 (-0.01, 0.006)	0.59	1.14
IS (ISS)	-0.515(-0.846,-0.143)	0.006	4.12	-0.170 (-0.541, 0.214)	0.39	4.12
PD	0.384(0.002, 0.082)	0.04	4.13	0.066(-0.036, 0.050)	0.74	4.13
PR	-0.123(-0.790, 0.175)	0.21	1.15	0.014 (-0.483, 0.553)	0.89	1.15

Discussion

Our results revealed that OA victims report significantly lower HRQoL than Portuguese population in most of its domains. Poorer HRQoL was mainly associated with higher IS and PD, and being professionally non-reintegrated. Personal dimensions showed limited influence, with exception of resilience that was consistently related to higher HRQoL. In multivariable models, IS, and RSA emerged as significant independent predictors of the physical–social HRQoL component.

HRQoL – injured and non-injured populations

Our results showed a consistent pattern of significantly lower HRQoL among injured workers when compared with Portuguese population norms, in almost all domains.

Marked reductions were observed in *Physical functioning* ($p<0.001$: $d=-0.70$), *Role-physical* ($p<0.001$: $d=-1.03$), *Bodily pain* ($p<0.001$: $d=-1.25$), *Vitality* ($p<0.001$: $d=-0.73$), *Social functioning* ($p<0.001$: $d=-0.47$), *Role-emotional* ($p<0.001$: $d=-0.61$), and *Mental health* ($p<0.001$: $d=-0.92$), all presenting medium to large effect sizes. These results are consistent with previous studies indicating that work-related injuries extend beyond physical sequelae, having persistent negative effects on self-rated pain, vitality, emotional dysregulation, psychological well-being, and social participation [92, 93, 96, 191-195, 199, 215]. These effects may negatively influence functional recovery, and long-term work outcomes [195, 215, 216].

No significant difference were observed on the *General health* domain ($p=0.51$: $d=0.07$). *General health* is a broad and subjective assessment of personal health status, which can remain relatively stable even when specific physical or emotional functions are compromised [91, 187], especially if medical assistance is being provided. We postulate that since participants were being medically assisted, their overall health global perception is relatively preserved, despite reporting substantial alterations in other HRQoL domains. Moreover, individuals may, and often do, adapt to changes in health conditions by adjusting their expectations and redefining their internal standards for what constitutes “good health” [186]. Such adaptative mechanisms may also explain why injured workers continue to rate their *General health* positively while simultaneously reporting substantial complaints such as pain, fatigue, or emotional limitations.

No significant differences were found on *Physical composite scale* ($p=0.15$: $d=0.14$) scores. Despite the lower scores in several mental health-related HRQoL domains, the *Mental composite scale* ($p=0.001$: $d=0.33$), score was slightly higher than Portuguese norms, albeit with a small effect size. Mechanisms of psychological adaptations and/or resilience may be underlying this result, as it will be discussed later. Furthermore, composite scores (PCS and MCS) are derived from standardized domain scores weighted using factor coefficients based on Portuguese normative data and therefore do not represent simple averages of the eight domains. These summary measures reflect relative positioning with respect to the reference population rather than absolute health status. Additionally, the presence of cross-loading negative weights between physical

and mental domains may lead to higher composite scores in specific samples despite limitations in some domains. Differences in sociodemographic characteristics between the clinical sample and the Portuguese normative population, as well as possible response-shift effects, may further explain unexpectedly higher composite scores and should be considered when interpreting these results.

Overall, these results reinforce the understanding that injured OA has sustained and multidimensional effects on injured workers' HRQoL.

HRQoL and personal dimensions

Our sample was predominantly composed by young male workers ($\bar{X}$ =44.7 years), working mainly in physically demanding areas (general services and trade, construction and plant and machinery operators), which imposes higher risks for sustaining traumatic injuries. These findings are consistent with national [166] and international [115-117, 119, 167, 168] data on OA. The mean age observed aligns with previous studies indicating that middle age adults are the most affected group, with potential implications for long-term health, work capacity, and socioeconomic outcomes [7, 61, 195].

Personal sociodemographic variables exhibited limited influence on HRQoL.

Sex group comparisons showed that female participants reported significantly worse scores on *Role-physical* (47.6 vs 54.3; $p=0.034$) and higher *Bodily pain* (47.6 vs 54.3; $p=0.034$), than man. Sex-based comparisons should be interpreted with caution due to the marked imbalance in group sizes (male $n=84$; female $n=17$), which reduces statistical power and increases susceptibility to Type I and Type II errors.

Similar results of higher pain prevalence and injury vulnerability among women after OA have been reported [115, 117]. For other HRQoL domains no differences were found regarding sex, in line with studies reporting mixed or attenuated sex effects on post-injury HRQoL [191, 192].

Participants aged under 50 years reported significantly higher scores in *General health* (64.3 vs 54.1; $p=0.005$) and *Vitality* (50.9 vs 42.1; $p=0.039$) domains than those aged 50 years or older. No significant differences were found at other HRQoL domains. These findings suggest that age is more strongly associated with subjective perceptions of overall health and personal energy, as expected. Other studies in the context of occupational injuries have found associations between older age and poorer self-rated health despite comparable functional outcomes [96, 117]. Overall, age appears to exert

a modest influence on HRQoL after an OA, primarily through global health perception rather than broader functional domains.

Marital status differences were minimal, with living alone participants showing slightly significant higher *General health* scores (66.8 vs 58.0; $p=0.041$), which contrasts with previous studies that highlighted the protective effect of marital support after an injury [201, 207].

Resilience domains were consistently positive associations with HRQoL (Table 14). Perception of self-correlated to nearly all HRQoL domains, suggesting self-confidence and competence help injured workers to cope with functional and psychological challenges following the OA. *Planned future* correlated with *Physical functioning* ($p=0.03$), *General health* ($p<0.001$), *Vitality* ($p<0.001$), and *Social functioning* ($p<0.001$), highlighting the role of goal-setting and future orientation in supporting better HRQoL [198]. *Family cohesion* and *Social resources* were moderately associated with *Physical functioning* ($p=0.02$; $p=0.02$), *Social functioning* ($p<0.001$; $p=0.003$), *Mental health* ($p=0.01$; $p=0.01$), emphasizing the protective role of social and familial support as a buffer to the psychological distress that can occur after an OA [47, 199, 209, 211, 212]. *Structured style* showed no correlations, suggesting that organization habits have limited influence on HRQoL after an OA. These results were reinforced by group comparisons, where results showed that higher resilience group had significant higher scores across most of HRQoL domains (Table 15). Studies across clinical and occupational populations have demonstrated that high resilience is associated with better psychological adjustment, fewer psychiatric symptoms, improved quality of life, even in the presence of pain or disability [198, 201, 211] which is consistent with our results. Overall, these findings align with previous research showing that positive self-perception, future orientation, and social competence support better HRQoL in individuals experiencing trauma or health-related stressors [198, 201, 209, 211, 212], underscoring the importance of incorporate resilience-building strategies during rehabilitation and recovery processes.

HRQoL and acute injury severity

Most participants sustained none-moderate injuries (71.3%). Acute injury severity was negatively correlated with *Vitality* ($p=0.04$), *Social functioning* ($p=0.01$), and both *Physical* ($p=0.04$), and *Mental composite scales* ($p=0.01$), indicating that more severe

injuries affected both physical and mental components of HRQoL. Participants with serious-critical injuries reported significantly lower *General health* (55.9 vs 62.7; $p=0.05$), *Vitality* (41.0 vs 50.6; $p=0.04$), and *Social Functioning* (52.6 vs 71.2; $p=0.012$), as well as *Physical* (47.6 vs 54.3; $p=0.034$) and *Mental Composite scales* (48.1 vs 59.8; $p=0.003$). The absence of significance differences between acute injury severity groups in *Role-physical* (41.4 vs 46.9; $p=0.458$) and *Role-emotional* (51.7 vs 62.5; $p=0.140$) domains may suggest that this may be mediated by contextual, familiar or workplace factors rather than by injury severity itself [97].

Our results are in line with previous research indicating that more severe occupational injuries are strongly associated with poorer HRQoL, including reduced physical functioning, social limitations, alterations on vitality and emotional well-being, higher pain levels, and delayed return to work [91-93, 96, 186, 191, 192, 195, 215].

HRQoL and PD

PD was assigned to 54.5% of the participants, reflecting the long-lasting sequelae of OA. Although PD average was low (5.0%), the range was substantial (Min=0%; Max=43.3%). However, it is known that even minor to mild disabilities can significantly affect individual well-being and consequently their HRQoL [108, 217], which reinforces the medico-legal relevance of evaluate the concrete personal damage (considering the different person life contexts according to the biopsychosocial model) instead of only corporal damage [66, 218]. To assure this demand, in Portugal PIA is based on a Three-dimensional Methodology [64, 65, 73], which allows the consideration of personal factors, including self-perceptions (subjectivity) [219].

PD demonstrated strong associations with HRQoL (Table 14). Groups comparison revealed that moderate-severe group scored significantly lower on *Physical functioning* (55.8 vs 66.6; $p=0.045$), *General health* (55.6 vs 62.9; $p=0.036$), *Vitality* (41.5 vs 50.6; $p=0.049$), and *Social functioning* (53.8 vs 70.9; $p=0.019$), as well as on both the *Physical* (47.4 vs 54.5; $p=0.027$) and *Mental Composite Scales* (49.0 vs 59.7; $p=0.006$), reflecting the impact of professional disability on HRQoL, as noted in other studies [96, 191, 193].

HRQoL and PR

Although all participants were considered capable of return to work at final PIA, 20% of the injured worker were not professionally reintegrated. Non-reintegrated group showed lower scores at all HRQoL domains, although significant differences were only found in *Bodily pain* (32.4 vs 42.0; $p=0.011$), and *Social Functioning* (51.9 vs 69.3; $p=0.023$). These results reinforce previous studies stating that better physical conditioning, social engagement, and self-confidence [76, 77, 97, 107, 108], measured by this HRQoL domains, are related to professional reintegration outcomes.

Regression Models

Physical and social aspects of HRQoL are significantly influenced by IS, and resilience, whereas mental/emotional aspects show weaker associations with the same predictors. These results highlight the need to prioritize physical and social recovery and rehabilitation interventions to improve overall quality of life in occupational injured individuals, as noted in previous studies [77, 96, 97, 107].

Limitations and further studies

This study has several limitations due to difficulties in accessing case studies. First, the methodological characteristics of a cross-sectional study design prevents causal inferences. Second, the use of a convenience sample which may introduce some selection bias. Third, the limitations resulting from sample dimension. Fourth, time since OA was not included as a variable in the statistical analyses. Finally, HRQoL was assessed at a single time point, preventing evaluation of changes in quality of life across different stages of recovery and rehabilitation.

Given the cross-sectional design, the associations observed between RSA, IS, PD, PR, and HRQoL should be interpreted as correlational rather than causal. While regression models identify significant predictors, the temporal directionality of these relationships cannot be established.

Despite the referred limitations, this work intends to be a starting point for other studies, fundamental for forensic and insurance medicine practice, but mainly to promote injured workers quality of life. Further studies aimed to understand the relationships between HRQoL, and these and other personal dimensions (for example, previous trauma experience and motivation), IS, PD, and PR, should be designed employing longitudinal methodologies, larger, more representative and balanced samples to enable

more robust investigation. Longitudinal designs are required to determine whether, for example, lower HRQoL impedes professional reintegration or whether unsuccessful reintegration exacerbates perceived quality of life [178, 217]. Furthermore, environmental factors (such as education, socioeconomic level, familial support, employer and peer support) should be included. Such studies would provide deeper insights into the trajectory of recovery and the long-term impact of occupational injuries on HRQoL and assess if it has a potential role on determining OA outcomes such as PD and PR.

Conclusions

Our study showed that OA impact injured workers HRQoL. We highlight the following results:

- a) OA is associated with multidimensional reductions in HRQoL, particularly in physical, vitality and social domains;
- b) Resilience, and IS emerge as independent predictors of HRQoL in multivariable models, whereas sociodemographic factors show limited influence;
- c) Professionally non-reintegrated workers showed lower HRQoL scores, with significant differences for *Bodily pain* and *Social functioning*.

Overall, OA injured workers HRQoL was broadly affected. Lower HRQoL was consistently and significantly related to low resilience, higher IS, higher PD, and being professionally non-reintegrated. The main HRQoL domains affected were *Physical functioning*, *General health*, *Vitality*, *Social functioning*, and both *Physical* and *Mental composite dimensions*.

Given these results we consider that systematic assessment during OA recovery, and professional rehabilitation and reintegration process should include HRQoL measures, repeated at several points. Multimodal interventions combining pain management programs, alongside with functional restoration of mobility, strength, and endurance, and task-specific occupational training are essential to promote adaptation to OA sequelae, self-perceived health, and work capacity [93, 96, 195]. Alongside psychological interventions, including screening for trauma-related symptoms, resilience-enhancing programs, and structured goal-setting to reinforce self-efficacy, orientation towards future professional and life projects, and confidence in individuals' professional capacities [201, 220], could help mitigating the effects of OA on *Role-*

emotional, Mental health, Vitality, and Social functioning HRQoL domains. Lower *Social functioning* (particularly among non-reintegrated workers and those with higher IS, and low resilience) also emphasizes the importance of workplace-focused strategies, including graded return to work programs, task modification, ergonomic adjustments, and employer and peer involvement.

All these findings underscore the need for a biopsychosocial approach to recovery, professional rehabilitation and reintegration process, and to medico-legal evaluation after an OA, that integrates physical rehabilitation, pain management, psychological support, resilience building, and workplace accommodations.

V. GENERAL DISCUSSION

This research on OA allowed an in-detailed analyse of the injured workers personal sociodemographics, injury severity and outcomes (including permanent professional damage), psychological stability, and HRQoL, as well as their impact on socio-professional reintegration.

We found that OA, beyond physical sequalae, may also produce psychological symptoms that, if not properly and early identified and treated, may become permanent with important repercussions in HRQoL and, consequently, on PR. This effect on PR will subsequently affect all the contexts of workers personal life, together with their families and society.

The findings may be useful for deep reflections about the challenges of rehabilitation and PR process after an OA and offer insights regarding what can positively/negatively influence its outcomes. As a result, they may add some contributions for assistance providers analyse and orientations for responses design, always considering the principal goal of promoting injured workers early and successful PR.

1. Workers, injuries and challenges for socio-professional reintegration

Our studies showed that injured workers were mainly male and young, both in severe ($\bar{X}$ =35.8 years) and more general cases ($\bar{X}$ =44.7 years). This demographic profile is in line with international and Portuguese epidemiological data, that consistently show higher occupational injury incidence rates among this group [111, 115-119, 166-168]. The overrepresentation of young male workers in OA cases seems to reflect their higher exposure to hazardous tasks. Furthermore, it reflects the higher concentration of men in more physically demanding professions and higher risk occupational sectors (general services and trade, construction, and manufacturing industries were the occupational areas where more OA occurred), as referred in literature [111, 112, 116, 119-123]. In these occupational contexts, opportunities for task modification or workplace accommodation are frequently more limited, particularly when job performance relies heavily on physical capacities that may be permanently or partially compromised following the OA. Consequently, in these situation PR often requires substantial job redesign or full professional reconversion, which is not always feasible or adequately supported, both for injured workers and employers.

Regarding schooling on general OA injured workers presented a low educational level ($\bar{X}$ =8.7 years), below the current mandatory level of education in Portugal (12 years). This result is of concern (although we haven't demonstrated it) since lower educational levels have been associated with increased risk of work absence, and unsuccessful PR outcomes after an OA [61, 76, 175-178]. Having low educational levels may diminish workers capacity to adapt to job alterations, and to perform different tasks, an essential competence specially in cases when a job adaptations and/or professional reconversion is needed. Fostering formal and informal professional training aimed at adding technical competences, as early as possible and specially whenever is acknowledge that job alterations (either partial or totally) are required is also a challenging in this context. Mostly injuries were orthopaedic affecting limbs. In severe cases neurological injuries emerged as the more prevalent. This is in accordance with Portuguese and international reports on occupational injuries [63, 76, 103, 113, 116, 118, 124, 127-129]. Results on injury severity consistently showed that more severe injuries, either measured at acute phase or based on professional disability outcomes, lead to poor PR outcomes. Although more severe injuries are frequently associated with poor PR outcomes, it can also be acknowledged that return to work is not solely determined by clinical recovery outcomes, but rather for a complex interaction between individual characteristics, workplace conditions, and broader contextual factors. This fact imposes a significant challenge for socio-professional reintegration that call for several actors and interactions, that need to work in an integrative way.

At the same time, reparation systems and perceived secondary gains have been shown to influence symptom reporting and rehabilitation trajectories, underscoring even more the complexity of psychosocial and systemic factors involved in socio-professional reintegration [46, 52, 146]. This challenge request not only further research but also active strategies aimed at offering clear information regarding reparation process so that no misconception about it remains.

In this context structured professional rehabilitation programs become crucial [53, 61, 89]. Equally important is the development of PR strategies and interventions that respond both to workers and workplace needs, since literature evidence that socio-professional successful outcomes results, among other things, from the capacity of both injured worker and work context to accommodate and adapt to OA impacts on functional and work capacity [32, 59, 76, 130]. To do so, integrated multidisciplinary teams and biopsychosocial approaches to PR are needed.

Thus, the challenges are complex, mainly because they are multifactorial, as it will be discussed further. In short, we can systematize them considering the following factors: clinical, personal, contextual (socioeconomic and familial, and work, insurance and court- related).

2. Socio-professional reintegration and Labour Law in Portugal

Portuguese labour law (Law No. 98/2009, September 4th) establishes the legal framework for the protection, reparation, and socio-professional reintegration of occupational injured workers. The OA legal definition explicitly reflects its multidimensional impact, and consequently the need for reparation of functional (physical and psychological) and professional consequences that may affect the workers' work and earning capacities.

Within this legal regime, the protection of workers' physical and psychological integrity is a fundamental principle. Accordingly, the law grants lifelong follow-up rights, including access to medical care, treatments, technical aids, and third-party assistance, through the responsible insurance company. This possibility acknowledges the dynamic nature of OA outcomes over time, particularly in more severe injuries, as they are related not only with earning capacity but also with socio-familial and personal factors. These factors interact bidirectionally with psychological stability and quality of life of the involved persons. In fact, literature reinforce this, with longitudinal studies consistently demonstrating that physical function, psychological status, and work capacity may change years after the initial injury, influencing long-term PR trajectories [93, 96, 130, 138, 221].

The legal regime further establishes employers' legal obligation to reintegrate the injured worker, by identifying professional activities compatible with their residual functional capacity, taken in account their age, education, qualifications, and professional experience (Law No. 98/2009, September 4th, Articles 44 and 155, No 1). Furthermore, it also states that PR may occur either within the worker's original occupational area or in another that is better adapted to their current functional status. To support this process, the law explicitly expresses that rehabilitation and PR services, can be activated and paid for, when necessary, as part of the reparation process. These measures include professional (re)training, job adaptation, and workplace accommodation, among other forms of support.

The Portuguese legal framework is well aligned with scientific evidence that PR outcomes are influenced not only by injury severity, but also by job demands, workplace accommodations, and the adjustment between workers functional capacity and their occupational tasks [32, 59, 61, 129, 130]. However, despite this comprehensive legal framework, this research results indicates that not all injured workers who were considered capable of return to work at the time of PIA, effectively did. This is of concern and seems to reflect that the legal framework *per se* does not guarantee the activation of all the assistance required to promote effective socio-professional reintegration. This calls for a need to examine the factors that hinder the operationalization of the legal established rights and to identify the actions needed to reduce the gaps between legislation and reality, for all cases.

In summary, Portuguese labour law provides a robust and comprehensive legal framework for socio-professional reintegration following an OA, grounded in the guarantee of reparation work-related damage that impact earning capacity, and the employer's responsibility to reintegrate workers according to their residual work capacity. Nevertheless, the findings reinforce the ongoing need for integrated and multidisciplinary approaches that effectively translate legal rights into sustainable PR outcomes for all workers considered capable of returning to work.

2.1. The role of insurance companies

As said before, in Portugal the responsibility for medical treatment, rehabilitation both of injury and professional, and reparation is allocated to insurance companies, that also have the responsibility to perform the first PIA, where the proposal of an eventual PD is made.

After an OA, injured worker frequently undergo a treatment period associated with some degree of temporary (total or partial) professional disability. This initial recovery period is particularly relevant, as the duration of temporary disability (and the consequent work absence) is an important predictor of long-term permanent outcomes and of return to work capacity [61, 83].

Therefore, rehabilitation and PR efforts must start at this phase, and as early as possible. To accomplish that insurance companies need to have a detailed information about ongoing treatments, and how injured workers are coping with them, occupational tasks and demands, and the impact of ones in another (interaction between functional

limitations and job demands). For that, a close articulation between treatment services, employers, and occupational medicine services both, from insurance company and job contexts, although challenging, is required.

Psychological screening should also be incorporated at this stage, not only in severe cases but also more frequently in less severe cases (if considered necessary), and as early as possible, given its well-established influence on PR outcomes [9, 35, 48, 61-63, 153]. To support this, recommendations about the importance of this assessment, as well on standardized and measurable screening procedures and validated instruments are needed. Furthermore, orientations regarding referrals to psychiatric and/or psychological treatment should also be provided.

Additionally, and given the relation that perceived HRQoL as shown with PR outcomes [93, 96, 98, 195], injured workers quality of life assessment could also be important to provide valuable insight into workers' subjective perceptions of the impact of injury across their life domains, allowing for early targeted interventions to mitigate this perception and its effects.

Finally, early return to work, even in the presence of partial temporary disability, is extremely important for recovery and perceived health status. It decreases the risk of psychological problems (such as depression), enhances social participation, increases a perceived usefulness, and improves quality of life and overall well-being [9-11]. In this context, insurance companies can contribute by not only defining the rate of partial temporary professional disability, but also in translating them into concrete guidance regarding real work context of the injured worker (permitted and forbidden tasks, necessary jobs adaptations, working times and restrictions during this period), together with occupational medicine whenever it is found necessary.

PIA assessment at the insurance company is very relevant and mandatory by law, whenever clinicians consider that they shouldn't discharge without the medical expert opinion. PIA is frequently grounded on the 3-DM, which considers and favours rehabilitation and PR. However, in a significant number of cases, PIA rely primarily on the National Permanent Disability Table (Decree law No. 352/2007, October 23rd), and considers mainly the body sequelae. This approach can limit the assessment's potential contribution to PR, as it may overlook functional, psychological, and contextual dimensions that are critical for planning return to work.

For this reason, it is crucial to assure that PIA (both the first and the subsequent) consistently include a structured 3-DM description. By doing so, PIA can assume the

role of an important tool to assist all those involved on injured workers professional reintegration. The detailed characterization of the person, together with an analysis of their capacities and limitations interact across different life and work contexts, facilitates effective communication and articulation between all professionals and institutions involved: medico-legal experts, professionals of rehabilitation and reintegration, occupational physicians, workplace advisors, insurance companies and even labour courts.

Furthermore, PIA may directly contribute to the understanding and management of the PR process, by documenting the return to work attempts made during recovery and rehabilitation, as well as the difficulties encountered, and adjustments implemented. This will just be possible with the contribution of other professionals with experience on PR, namely social assistants and psychologists that make an in-local contact with worker, employer and occupational physician (whenever possible), promoting the articulation between these parts and updating the expert about the case evolution. This information can support evidence-based decisions and inform the definition, and revision of personalized PR plans, especially in cases where challenges emerged during the partial PD periods [74].

A core responsibility of the first PIA is the assessment and attribution of PD, including its type and degree. While this attribution is important to the reparation process, it also has a crucial role in PR. PD assignment must be grounded in a realistic understanding of worker's professional context, which is only possible with a close knowledge about professional tasks, company dimension and other job occupations, and in articulation with occupational medicine professionals.

2.2. The role of employers and occupational medicine

Employers and occupational medicine physicians assume an extremely important and central role in promoting early, sustainable and adjusted to injured workers capacities trajectories of return to work. And even if it was out of the scope of the present research due to difficulties on access to data, we consider important to discuss this subject.

There is substantial evidence that companies and workplace early engagement and adaptability is extremely important in socio-professional reintegration outcomes. Studies across different reparation systems demonstrate that early employer involvement, and the existence of structured return to work programs are associated

with improved reintegration rates, whereas fragmented systems and administrative complexity may hinder recovery and prolong not only work absence but also PD [59, 83, 221]. Workplace flexibility, allowing for work adaptation, task redistribution, and the implementation of alternative or modified jobs, have been reported as associated with higher return to work rates and shorter durations of temporary professional disability [55, 89]. Employers have therefore the role and responsibility of, not only comply to legal obligations, but also to assist in identifying injured worker job demands and attributions, as well as other existing tasks that can be compatible with worker remain capacity. It is important that this joint work initiates as early as possible, allowing a progressive and well succeed return to work.

Occupational medicine professionals, in turn, emerge as key elements in bridging the worker's clinical condition with workplace tasks and demands, and organizational constraints. For doing so, it is important that information regarding jobs description, required professional limitations or adaptations are well described, and integrated with the injury outcomes at every stage of the rehabilitation and reintegration process. For that a biopsychosocial approach is essential to incorporate the physical and psychological status, perceived work ability, self-efficacy, and contextual workplace when analysing professional aptitude [75, 220]. Furthermore, given the fact that psychological disorders are frequently underdiagnosed after OA, occupational medicine being a more proximal service can be of assistance in this identification during the rehabilitation and reintegration phase, and even after it.

PR should be understood as a dynamic and longitudinal process, often characterized by partial returns, functional role changes, and persistent psychological impact. This underscores the need for continuous monitoring and progressive workplace adjustments [63, 76], in which both employers and occupational medicine professionals have an essential contribution.

2.3. The role of courts and NILMFS

After the first insurance company PIA, the resulting report is sent to the Public Prosecutor's Office of the respective labour court, whenever a PD is proposed. In this case, a new PIA is required by Law to the NILMFS to try an agreement between parts, as described before in the general introduction of this research. However, in this context, which seems more relevant to point out is that the medical expert of the

NILMFS may benefit of more concrete and objective information in more complex expertise cases where the procedures for PR, above described, had already been performed and even accomplished. This will allow him/her to offer a more detailed and justified conclusions medico-legal report to court.

All these intervention steps considered by Law, aim to protect the rights of the victims, and consequently justice administration, but in certain cases they are a cause of undesirable delay for the conclusion of the judicial process with negative consequences for workers, their families, insurance companies, and all society. That's why there is a need for further analysis and studies to define if the OA cases that nowadays enter in Labour Law system need indeed to fall all these steps or, as it happens in another countries, just cases with more complexity should be analysed at that level (e.g., with a PD over 10 or 15%) [222, 223].

3. Professional reintegration

Return to work, whenever possible, constitute a milestone of restoring a sense of competence and normality in occupational victims and their family's life [9-11, 75].

Work provides a context were: (a) coping skills to deal with disabilities can be learned and trained [47, 77]; (b) physical conditioning and functionality can be improved [47, 77]; (c) a sense of self-efficacy can be recapture [47, 61, 83]; (d) social support and recognition can be obtained [75, 84]. All this major contributes to injured workers HRQoL [47, 77].

Knowing this, recovery and professional rehabilitation and reintegration has an extreme important role on assist, from day one, injured workers at achieving their best potential level to allow them to return to work, as early as possible.

This requires the intervention of multiple institutions and professionals, that often are not within neither the same institution, nor the same government department, which leads to important challenges to be reflected upon.

3.1. Challenges

It cannot be stressed enough that ensuring effective PR following an OA is of utmost importance. But it is also a complex process, where multiple variables interact.

So, what may be keeping injured workers away from PR?

This research has shown that even if at first PIA injured workers are considered capable of return to work, with or without PD, that is not reflected on actual PR for all cases. This may be due to several factors, as the following:

- a) *Clinical* [66]: severity of the OA mechanism; injuries severity; perception of imminent death; time to diagnosis; types and quality of treatments; time to rehabilitation and its quality; adequate use of technology and adaptations; professional empathy;
- b) *Personal* [9, 33, 46, 47, 52-55, 72, 74, 80, 146, 178]: age (demotivation due retirement closeness and work market constraint in older adults); sex; education level and cognitive abilities and skills that can impact communication, and the capacity and willingness to learn new skills; profession; previous health status (including psychological conditions); lifestyle (considering also substances consumption); previous traumatic experiences; resilience; motivation to return to work or involvement on reintegration efforts required and the worker's perceived gain; difficulties in coping with the discomfort provoked from returning to the same professional context; low tolerance for pain or other functional limitations; self-perceived physical and psychological poor health; capacity to adapt to job modifications or reconversion, as well as to the use of technology; OA outcomes expectations; financial reparation expectations sometimes with the search of increased gains and even fraud; prejudice towards insurance companies clinicians and experts duty of professional impartiality; the misconception that return to work may decrease the amount of financial reparation (indexed to PD rate), and the subsequent possible exaggeration of clinical situation severity and/or poor engagement of rehabilitation;
- c) *Socioeconomic and familial* [39, 137, 224, 225]: financial instability; lack of support; alterations on family roles and attributions; difficulties on relationships due to the stress and the capacities changes; difficulties on adaptations of some previous home features;
- d) *Work-related* [44, 46, 52-55, 74, 77, 89]: difficulties in adapting tasks compatible with the worker's new functionalities, especially in smaller and medium-sized enterprises; companies reluctance or lack of interest in having workers with disabilities, using OA as a pretext to end employment relationship; lack of or reduced peer support and sometimes even stigmatization, discrimination or harassment; limited awareness, about the importance of early

professional rehabilitation to promote health and recovery; absence of continuous presence of occupational physicians in small and medium-sized enterprises; when injured person is simultaneously the employer; lack of knowledge and awareness about employer's legal obligation to find tasks compatible with the functional state of the worker:

- e) *Insurance and court-related*: the system complexity namely the reparation procedures; lack of professional training of all professionals involved regarding law and insurance medicine; flaws and errors in procedures followed and in the instruments used, which date back many years and have been normalized over time, than corrected on the basis of the scientific evidence that as continued to emerge; flaws in the communication between these several actors; flaws on expertise and reparation focus (object and objective).

3.2. Proposals

In Portuguese context multiple institutional actors (insurance companies, healthcare providers, rehabilitation staff, medical expert and occupational physicians, social workers, employers, professional and vocational rehabilitation centers, NILMCS, labour courts, and social security, among others) may at some point be called to intervene in the PR process.

But we still have a fragmented system for PR of injured workers, where an integrated and systematic analyses of all factors that contribute to the outcome are lacking. It is extremely important that assessment, rehabilitation and reintegration process keep in mind its object and aim: restore the injured worker functionality (as a person), and reestablish his/her earning capacity, considering him/her personal and contextual (where professional is included) reality.

Some proposals regarding responses design will be made below.

First, regardless of whether the services are funded by public or private sectors, and of the government department to which they report (Health, Work and Social Security, and Justice), communication and coordination along the process of PR should be easy, fast and integrated. So, referral from ones to another should be guaranteed.

Secondly, information regarding treatment and rehabilitation, description of job tasks and demands, and the analyses of the relation between both should be made at each point of the process. The assessments are made to inform about treatment needs and progress, finishing frequently with PIA, but since the aim is to restore professional

capacity, the information must reflect upon that. So, employers and occupational physicians need to be involved in the process from its beginning, allowing real context professional tasks description, as well as analyses of professional needed adaptations or alterations that can be tested during partial professional disability periods.

Thirdly, the person and his/her family (when needed) must also be involved, listen to, and respected regarding all measures and decisions that will take place concerning his/her health and PR. During this process psychological screening may be conducted, preventing the evolution of psychological disorders (that may emerge due to the difficulties and life changes that such an event promotes), and giving support to a healthier adaptation through the process, assuring that good levels of motivation for PR are maintained.

Finally, treatment services should include multimodal interventions combining pain management programs, alongside with functional restoring, and task-specific occupational training. Alongside psychological interventions, including screening for trauma-related symptoms, resilience-enhancing programs, and structured goal setting to reinforce self-efficacy, orientation towards future professional and life projects, and confidence in individuals' professional capacities. Furthermore, structured return-to-work programs should be developed, including job adaptations, accommodations and information related to financial support.

So, the early engagement and articulation between all these institutions and professionals, is essential and an important predictor of good professional outcome and therefore must be reinforced [32, 53, 54, 59, 83]. Albeit the inherent complexity of these multidisciplinary intervention (often regulated by different financial sectors, public and private), is essential to develop an integrated intervention system organized in a transdisciplinary way.

VI. FINAL CONSIDERATIONS

This research contributed to a better knowledge about OA related outcomes, namely PR. We consider it offers some important contributions to support clinical recovery and rehabilitation practices, medico-legal assessment, and professional rehabilitation and reintegration, in promoting higher rates of successful return to work, even in cases when PD remains.

In the three studies conducted during this research project about OA outcomes, we concluded, respectively:

- a) In severe cases not all workers that were considered capable of return to work, even with PD were professionally reintegrated, suggesting the need of a profound analyse about the contribute of medical insurance clinicians and experts on promoting PR plan before discharge, and before PIA, having into consideration the real professional context of the injured worker;
- b) Psychological symptoms are frequent among injured workers, and higher on non-professional reintegrated ones, highlighting their relationship with PR and the need for early symptom identification and treatment, when required;
- c) Injured workers HRQoL is lower than the observed on Portuguese general population, and the scores are worst, in almost all dimensions, for non-professional reintegrated workers, reflecting the importance of this measure during recovery and professional rehabilitation and reintegration processes.

The described findings underscore the need for a multimodal and biopsychosocial approach to assessment and intervention after an OA. PIA must also include the assessment of concrete aspects of victim's professional reality and how it is related to injury outcomes and individual remaining capacities. This calls, in the assessment period, for an articulation between all institutions and professionals assisting injured workers, including employers and occupational physicians, as well psychological and other professionals of rehabilitation, either for victims and, in some cases, for their families, to promote successful socio-professional reintegration.

In summary, we want to state that OA cases intervention for effective socio-professional reintegration needs:

- a) A new look over people's health within their real life contexts;
- b) More focus on the object of the intervention (person) and its objectives (qualified treatment, rehabilitation and PR), with respect for good practices and defined guidelines for each kind of technical intervention;
- c) Training of the involved professionals on both insurance medicine and insurance law;
- d) Evidence-based interventions and decisions, considering the best interest of each person;
- e) Articulation and cooperation between all involved institutions and professionals;
- f) Humanized services (health, insurance, medico-legal, and justice), involving the person and his/her family on decision-making;
- g) Workplace humanization, in an ethical and dignifying way, respecting the person limitations.

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APPENDIX

1. Appendix A: Data assessment and collection insurance company authorization

Estamos muito comprometidos com a vertente pedagógica e científica da nossa Unidade de Avaliação do Dano Pessoal, pelo que estamos disponíveis para dar a nossa total colaboração ao projeto em apreço, decorrente do protocolo celebrado com a FMUP, que muito nos honra.

Apresento respeitosamente, os mais cordiais cumprimentos,

Laurentina Caldeira

Direção Negócio Acidentes de Trabalho e Pessoais

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From: Teresa Maria Salgado Magalhaes [EE] (DNT)
Sent: segunda-feira, 17 de setembro de 2018 16:32
To: Laurentina Conceição Santos Caldeira (DNT) <laurentina.santos.caldeira@fidelidade.pt>
Subject: Pedido de colaboração científica

Caríssima Sra. Dra. Laurentina Caldeira,

Na sequência do protocolo de cooperação científica celebrado entre a Fidelidade e a FMUP, venho apresentar a V. Exa. projecto de investigação para tese de doutoramento em Ciências Forenses, na área do dano pessoal e reabilitação, a realizar pela Dra. Isabel Almeida do centro de Reabilitação Profissional de Gaia.

2. Appendix B: Ethical Committee Approval



Questionário para submissão de Investigação

Exmo. Sr. Presidente da Comissão de Ética do Centro Hospitalar de São João/
Faculdade de Medicina da Universidade do Porto,

Pretendo realizar a investigação infracitada, solicito a V. Exa., na qualidade de Investigador, a sua apreciação e a elaboração do respetivo parecer. Para o efeito, anexo toda a documentação requerida.

IDENTIFICAÇÃO DO ESTUDO

Título da investigação: Work related accidents. The impact of severe morphofunctional aftereffects at persons reintegration.

Nome do investigador: Isabel Marie Silva Almeida

Endereço eletrónico: isabel.almeida@crpg.pt

Contacto telefónico: 914259796

Caracterização da investigação:

☒ Estudo retrospectivo

☐ Estudo observacional

☐ Estudo prospetivo

☐ Inquérito

☐ Outro. Qual?

Tipo de investigação:

☐ Com intervenção

☒ Sem intervenção

Formação do investigador em boas práticas clínicas (GCP): ☒ Sim ☐ Não

Promotor (se aplicável):

Nome do orientador de dissertação/tese (se aplicável): Professora Doutora Teresa Magalhães

Endereço eletrónico: tmaga@med.up.pt

Local/locais onde se realiza a investigação: Fidelidade

Data prevista para início: 01 / 12 / 2018

Data prevista para o término: 31 / 01 / 2020

PROTOCOLO DO ESTUDO

Síntese dos objetivos:

- Descrever e caracterizar as sequelas físicas, após acidente de trabalho, e as restrições funcionais que as mesmas colocam ao desempenho das pessoas nas atividades e participação nos seus contextos de vida;
- Compreender os efeitos das consequências morfofuncionais severas decorrentes dos acidentes de trabalho na participação dos indivíduos nos seus vários contextos de vida;
- Analisar as dificuldades na participação social, familiar e profissional decorrentes das sequelas morfofuncionais.

Fundamentação ética (ganhos em conhecimento/ inovação; ponderação benefícios/ riscos):

Este estudo pretende aumentar a compreensão acerca do tipo de sequelas morfofuncionais associada a um bom prognóstico de reintegração socioprofissional, e as que estão associadas a um mau prognóstico de resultado de reintegração, após acidente de trabalho. Dado tratar-se de um estudo retrospectivo não se considera existirem riscos associados à sua realização. A recolha de informação será efetuada a partir dos processos clínicos existentes. Como benefício considera-se que o mesmo permitirá ter uma melhor caracterização dos acidentes de trabalho em termos dos seus impactos físico, profissionais e sociais, e das questões relacionadas com a reintegração socioprofissional das vítimas. Pretende-se que os resultados obtidos permitam uma maior compreensão de quais os fatores que estão mais associados a uma boa reintegração socioprofissional após os acidentes de trabalho, contribuindo para o desenvolvimento de serviços de avaliação e reabilitação focados no desenvolvimento dos mesmos, sempre que possível. Considera-se que a análise efetuada de ligação entre as sequelas e a reintegração é inovadora.

CONFIDENCIALIDADE

De que forma é garantida a anonimização dos dados recolhidos de toda a informação?

A cada participante será atribuído um ID. O ficheiro que identifica o nome será independente e de acesso apenas pelo investigador.

O investigador necessita ter acesso a dados do processo clínico? ☒ Sim ☐ Não

Está previsto o registo de imagem ou som dos participantes? ☐ Sim ☒ Não

Se sim, está prevista a destruição deste registo após o sua utilização? ☐ Sim ☐ Não

CONSENTIMENTO

O estudo implica recrutamento de:

Doentes: ☒ Sim ☐ Não Voluntários saudáveis: ☐ Sim ☒ Não

Menores de 18 anos: ☐ Sim ☒ Não

Outras pessoas sem capacidade do exercício de autonomia: ☐ Sim ☒ Não

A investigação prevê a obtenção de Consentimento Informado: ☐ Sim ☒ Não

Se não, referir qual o fundamento para a isenção:

Existe informação escrita aos participantes: ☐ Sim ☒ Não

PROPRIEDADE DOS DADOS

A investigação e os seus resultados são propriedade intelectual de:

☐ Investigador ☐ Promotor ☒ Ambos ☐ Serviço onde é realizado

☐ Não aplicável Outro: _____

BENEFÍCIOS, RISCOS E CONTRAPARTIDAS PARA OS PARTICIPANTES

Benefícios previsíveis:

não aplicável

Riscos/incómodos previsíveis:

não aplicável

São dadas contrapartidas aos participantes:

· pela participação ☐ Sim ☐ Não ☒ Não aplicável

· pelas deslocações ☐ Sim ☐ Não ☒ Não aplicável

· pelas faltas ao emprego ☐ Sim ☐ Não ☒ Não aplicável

· por outras perdas e danos ☐ Sim ☐ Não ☒ Não aplicável

CUSTOS / PLANO FINANCEIRO

Os custos da investigação são suportados por:

☐ Investigador ☐ Promotor ☐ Serviço onde é realizado

☒ Não aplicável Outro: _____

Existe protocolo financeiro? ☐ Sim ☒ Não

LISTA DE DOCUMENTOS ANEXOS

- ☐ Pedido de autorização ao Presidente do Conselho de Administração do Centro Hospitalar de São João (se aplicável)
- ☐ Pedido de autorização à Diretora da Faculdade de Medicina da Universidade do Porto (se aplicável)
- ☒ Protocolo do estudo
- ☒ Declaração do Diretor de Serviço onde decorre o estudo
(sendo um estudo na área de enfermagem deve anexar também a concordância da chefia de enfermagem)
- ☐ Profissional de ligação
- ☒ Informação dos orientadores
- ☒ Informação ao participante
- ☒ Modelo de consentimento
- ☒ Instrumentos a utilizar (inquéritos, questionários, escalas, p.ex.). Ficha de colheita de dados no descritivo do estudo
- ☒ Curriculum Vitae abreviado (máx. 3 páginas)
- ☐ Protocolo financeiro
- ☐ Outros:

COMPROMISSO DE HONRA E DECLARAÇÃO DE INTERESSES

Declaro por minha honra que as informações prestadas neste questionário são verdadeiras. Mais declaro que, durante o estudo, serão respeitadas as recomendações constantes da Declaração de Helsínquia (1960 e respetivas emendas), e da Organização Mundial da Saúde, Convenção de Oviedo e das "Boas Práticas Clínicas" (GCP/ICH) no que se refere à experimentação que envolve seres humanos. Aceito, também, a recomendação da CES de que o recrutamento para este estudo se fará junto de doentes que não tenham participado em outro estudo, nos últimos três meses. Comprometo-me a entregar à CES o relatório final da investigação, assim que concluído.

Porto, 11 de outubro de 2018

Nome legível: Isabel Maria Silva Almeida

Isabel Almeida
assinatura

Parecer da Comissão de Ética do Centro Hospitalar de São João/FMUP

Emitido na reunião plenária da CE de 19/09/19

A Comissão de Ética para a Saúde ~~FMUP~~
APROVA a realização deste projecto de
investigação na sua actual conformidade.

Filipe Almeida

Prof. Doutor Filipe Almeida
Presidente da Comissão de Ética

Parecer da Comissão de Ética para a Saúde do
Centro Hospitalar Universitário de São João / Faculdade de Medicina da Universidade do Porto

Título do Projecto: Work related accidents. The impact of severe morphofunctional aftereffects at persons reintegration

Nome da Investigadora Principal: Dra. Isabel Maria Silva Almeida

Onde decorre o Estudo: Na Companhia de Seguros Fidelidade (no âmbito de parceria com a FMUP).

Objectivos do Estudo:

Este trabalho de investigação tem como principais objectivos descrever e caracterizar as sequelas físicas, após acidente de trabalho, e as restrições funcionais que as mesmas colocam ao desempenho das pessoas nas actividades e participação nos seus contextos de vida; compreender os efeitos das consequências morfofuncionais severas decorrentes dos acidentes de trabalho na participação dos indivíduos nos diversos contextos de vida; analisar as dificuldades de participação social, familiar e profissional decorrente das sequelas morfofuncionais.

Estudo realizado no âmbito do Doutoramento em Ciências Forenses da FMUP, sob orientação da Prof.^a Doutora Teresa Magalhães.

Concepção e Pertinência do estudo:

Este estudo pretende aumentar a compreensão acerca do tipo de sequelas morfofuncionais associada a um bom prognóstico de reintegração socioprofissional, e as que estão associadas a um mau prognóstico de resultado de reintegração, após acidente de trabalho.

A amostra será constituída por 120 pessoas, entre os 18 e os 64 anos, que sofreram um acidente de trabalho, e foram acompanhadas pela Companhia de Seguros Fidelidade.

Tem uma ficha de colheita de dados, devidamente anonimizada.

Benefício/risco: Não aplicável

Confidencialidade dos dados: A cada participante será atribuído um ID. O ficheiro que identifica o nome será independente e de acesso apenas pelo investigador.

Respeito pela liberdade e autonomia do sujeito de ensaio: Não aplicável

Curriculum da investigadora: Adequado à investigação.

Data previsível da conclusão do estudo: Janeiro de 2020

Conclusão: Proponho um parecer favorável à realização deste projecto de investigação.

Porto, 19 de Julho de 2019

O Relator da CES,

Pedro Brito



Questionário para submissão de Investigação

Exmo. Sr. Presidente da Comissão de Ética do Centro Hospitalar de São João/
Faculdade de Medicina da Universidade do Porto,

Pretendendo realizar a investigação infracitada, solicito a V. Exa., na qualidade de Investigador, a sua apreciação e a elaboração do respetivo parecer. Para o efeito, anexo toda a documentação requerida.

IDENTIFICAÇÃO DO ESTUDO

Título da investigação: The impact of work related accidents morphofunctional and emotional consequences and its impacts and relat

Nome do investigador: Isabel Maria Silva Almeida

Endereço eletrónico: isabel.almeida@crpg.pt

Contacto telefónico: 914259796

Caracterização da investigação:

☒ Estudo retrospectivo

☐ Estudo observacional

☐ Estudo prospetivo

☐ Inquérito

☐ Outro. Qual?

Tipo de investigação:

☐ Com intervenção

☒ Sem intervenção

Formação do investigador em boas práticas clínicas (GCP): ☐ Sim ☐ Não

Promotor (se aplicável):

Nome do orientador de dissertação/tese (se aplicável): Professora Doutora Teresa Magalhães

Endereço eletrónico: tmaga@med.up.pt

Local/loais onde se realiza a investigação: Fidelidade

Data prevista para início: 01 / 01 / 2019

Data prevista para o término: 03 / 03 / 2021

PROTOCOLO DO ESTUDO

Síntese dos objetivos:

- Caracterizar os impactos dos acidentes de trabalho a nível familiar, financeiro, social e profissional.
- Analisar a interação entre os impactos acima identificados e a reintegração socioprofissional e familiar das vítimas.
- Identificar preditores, nas dimensões acima referidas, relacionados com bons resultados a nível da reintegração socioprofissional e familiar.

Fundamentação ética (ganhos em conhecimento/ inovação; ponderação benefícios/riscos):

O presente estudo pretende contribuir para a compreensão dos diversos impactos decorrentes dos acidentes de trabalho, e da sua relação com a reintegração socioprofissional e familiar. Pretende-se identificar eventuais áreas que potenciem a reintegração das vítimas de forma a apoiar / informar processos de reabilitação após acidentes de viação.

Não existem riscos associados o estudo.

CONFIDENCIALIDADE

De que forma é garantida a anonimização dos dados recolhidos de toda a informação?

A cada participante será atribuído um ID. O ficheiro que identifica o nome será independente e de acesso apenas pelo investigador.

O investigador necessita ter acesso a dados do processo clínico? ☒ Sim ☐ Não

Está previsto o registo de imagem ou som dos participantes? ☐ Sim ☒ Não

Se sim, está prevista a destruição deste registo após o sua utilização? ☐ Sim ☐ Não

CONSENTIMENTO

O estudo implica recrutamento de:

Doentes: ☒ Sim ☐ Não Voluntários saudáveis: ☐ Sim ☒ Não

Menores de 18 anos: ☐ Sim ☒ Não

Outras pessoas sem capacidade do exercício de autonomia: ☐ Sim ☒ Não

A investigação prevê a obtenção de Consentimento Informado: ☒ Sim ☐ Não

Se não, referir qual o fundamento para a isenção:

Existe informação escrita aos participantes: ☒ Sim ☐ Não

PROPRIEDADE DOS DADOS

A investigação e os seus resultados são propriedade intelectual de:

☐ Investigador ☐ Promotor ☒ Ambos ☐ Serviço onde é realizado

☐ Não aplicável Outro: _____

BENEFÍCIOS, RISCOS E CONTRAPARTIDAS PARA OS PARTICIPANTES

Benefícios previsíveis:

Possibilidade de identificação de alterações emocionais.

Riscos/incómodos previsíveis:

Inexistentes.

São dadas contrapartidas aos participantes:

· pela participação ☐ Sim ☒ Não ☐ Não aplicável

· pelas deslocações ☐ Sim ☐ Não ☒ Não aplicável

· pelas faltas ao emprego ☐ Sim ☐ Não ☒ Não aplicável

· por outras perdas e danos ☐ Sim ☐ Não ☒ Não aplicável

CUSTOS / PLANO FINANCEIRO

Os custos da investigação são suportados por:

☐ Investigador ☐ Promotor ☐ Serviço onde é realizado

☒ Não aplicável Outro: _____

Existe protocolo financeiro? ☐ Sim ☒ Não

LISTA DE DOCUMENTOS ANEXOS

- ☐ Pedido de autorização ao Presidente do Conselho de Administração do Centro Hospitalar de São João (se aplicável)
- ☐ Pedido de autorização à Diretora da Faculdade de Medicina da Universidade do Porto (se aplicável)
- ☒ Protocolo do estudo
- ☒ Declaração do Diretor de Serviço onde decorre o estudo
(sendo um estudo na área de enfermagem deve anexar também a concordância da chefia de enfermagem)
- ☐ Profissional de ligação
- ☒ Informação dos orientadores
- ☒ Informação ao participante
- ☒ Modelo de consentimento
- ☒ Instrumentos a utilizar (Inquéritos, questionários, escalas, p.ex.) em anexo ao projeto de estudo
- ☒ Curriculum Vitae abreviado (máx. 3 páginas)
- ☐ Protocolo financeiro
- ☐ Outros:

COMPROMISSO DE HONRA E DECLARAÇÃO DE INTERESSES

Declaro por minha honra que as informações prestadas neste questionário são verdadeiras. Mais declaro que, durante o estudo, serão respeitadas as recomendações constantes da Declaração de Helsínquia (1960 e respetivas emendas), e da Organização Mundial da Saúde, Convenção de Oviedo e das "Boas Práticas Clínicas" (GCP/ICH) no que se refere à experimentação que envolve seres humanos. Aceito, também, a recomendação da CES de que o recrutamento para este estudo se fará junto de doentes que não tenham participado em outro estudo, nos últimos três meses. Comprometo-me a entregar à CES o relatório final da investigação, assim que concluído.

Porto, 11 de outubro de 2018

Nome legível: Isabel Maria Silva Almeida

Isabel Almeida
assinatura

Parecer da Comissão de Ética do Centro Hospitalar de São João/FMUP

Emitido na reunião plenária da CE de 19/07/19

A Comissão de Ética para a Saúde ~~FMUP~~
APROVA a realização deste projecto de
investigação na sua actual conformidade.

[Assinatura]
Prof. Doutor Filipe Almeida
Presidente da Comissão de Ética

Parecer da Comissão de Ética para a Saúde do
Centro Hospitalar Universitário de São João / Faculdade de Medicina da Universidade do Porto

Título do Projecto: The impact of work related accidents morphofunctional and emotional consequences and its impacts and relation with socio-professional and family reintegration

Nome da Investigadora Principal: Dra. Isabel Maria Silva Almeida

Onde decorre o Estudo: Na Companhia de Seguros Fidelidade (no âmbito de parceria com a FMUP).

Objectivos do Estudo:

Este trabalho de investigação tem como principais objectivos caracterizar o impacto dos acidentes de trabalho a nível familiar, financeiro, social e profissional; analisar a interação entre os impactos acima identificados e a reintegração socioprofissional e familiar das vítimas; identificar preditores, nas dimensões acima referidas, relacionadas com bons resultados a nível da reintegração socioprofissional e familiar.

Estudo realizado no âmbito do Doutoramento em Ciências Forenses da FMUP, sob orientação da Prof.ª Doutora Teresa Magalhães.

Concepção e Pertinência do estudo:

Este estudo pretende contribuir para a compreensão dos diversos impactos decorrentes dos acidentes de trabalho, e da sua relação com a reintegração socioprofissional e familiar das vítimas. Pretende-se, ainda, identificar áreas que potenciem a reintegração das vítimas de forma a apoiar / informar processos de reabilitação após acidentes de trabalho.

A amostra será constituída por 120 pessoas, entre os 18 e os 64 anos, que sofreram um acidente de trabalho, e foram acompanhadas pela Companhia de Seguros Fidelidade.

Tem uma ficha de colheita de dados, devidamente anonimizada.

A participação no estudo implica uma pequena entrevista e o preenchimento de um questionário, com uma duração estimada de cerca de 40 minutos, em que serão utilizados os seguintes instrumentos: Inventário de avaliação do dano corporal (Magalhães, 1998); SF-36v2 Questionário de Estado de Saúde; a Escala de Resiliência para adultos (Pereira et al, 2016); Work and Social Adjustment Scale (WSAS), Patient Health Questionnaire (PHQ-9).

Estão definidos os critérios de inclusão e de exclusão para a participação no estudo.

Benefício/risco:

O incómodo do tempo dispendido no preenchimento dos questionários.

Confidencialidade dos dados:

A cada participante será atribuído um ID. O ficheiro que identifica o nome será independente e de acesso apenas pelo investigador.

Respeito pela liberdade e autonomia do sujeito de ensaio:

Dispõe de uma adequada informação ao participante e de modelo de consentimento informado.

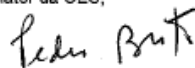
Curriculum da investigadora: Adequado à investigação.

Data previsível da conclusão do estudo: Março de 2021

Conclusão: Proponho um parecer favorável à realização deste projecto de investigação.

Porto, 19 de Julho de 2018

O Relator da CES,



3. Appendix C: Informed consent for studies 2 and 3

Consentimento Informado

Projeto: “desafios e percursos para a reintegração socioprofissional após um acidente de trabalho”

Caro Sr. / Sra.

Convidamo-lo a participar no estudo “Sintomas psicológicos , qualidade de vida relacionada com a saúde, e reintegração profissional após um acidente de trabalho. Um estudo intersectorial.”

Este estudo tem como objetivo compreender a relação entre as consequências resultantes de acidentes de trabalho/ acidentes de viação na reintegração socioprofissional das pessoas. Para tal serão analisadas dimensões que possam estar relacionadas, positiva ou negativamente, com a reintegração social e profissional, nomeadamente: a dor, as alterações físicas e funcionais, a estabilidade emocional, e qualidade de vida relacionada com a saúde, a capacidade de ajuste social e profissional, e a resiliência perante este acontecimento de vida.

A sua participação envolve um momento de recolha de informação, no qual serão realizados uma pequena entrevista e o preenchimento de um questionário. No seu conjunto, a entrevista e o questionário, terão a duração aproximada de 40 minutos, e será realizada na Fidelidade/ CRPG. Toda a informação recolhida e os seus resultados são completamente independentes do processo a decorrer relativamente ao seu acidente de trabalho.

Todas as informações que forem recolhidas serão estritamente anónimas e confidenciais, e serão apenas utilizadas para efeitos de tratamento e análise com vista a publicações e apresentações de âmbito científico. Teremos todo o gosto em partilhar consigo os resultados que vierem a ser públicos no âmbito deste projeto, desde que sejam solicitados por si.

A sua colaboração é voluntária, e a decisão de participar ou não participar, não acarreta qualquer consequência. Poderá inclusive desistir do estudo, se e quando o entender.

Se tiver alguma dúvida, poderá esclarecê-la junta da pessoa que lhe forneceu estas informações, ou através dos seguintes contactos: isabel.almeida@crpg.pt / 91 425 97 96.

Obrigada pela sua colaboração,
Isabel Almeida

CONSENTIMENTO INFORMADO

ESTUDO: “Sintomas psicológicos , qualidade de vida relacionada com a saúde, e reintegração profissional após um acidente de trabalho. Um estudo intersectorial.”

Após estes esclarecimentos, eu confirmo que:

- li e entendi a informação a respeito do estudo,
- me foi dada a possibilidade de esclarecer todas as eventuais dúvidas sobre a minha participação no estudo,
- recebi uma cópia deste consentimento.

Ao assinar este consentimento informado, aceito participar no estudo ““Sintomas psicológicos , qualidade de vida relacionada com a saúde, e reintegração profissional após um acidente de trabalho. Um estudo intersectorial”

Aceito ainda que a informação – que será mantida anónima e confidencial – seja utilizada em publicações científicas, às quais poderei ter acesso mediante solicitação.

Data: _____

Assinatura: _____

4. Appendix D: Study 1 – Published paper

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Research Paper

The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution

Isabel Almeida^{a,b,*}, José Manuel Teixeira^c, Teresa Magalhães^{a,c,d}

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^b CRPG – Centro de Reabilitação Profissional de Gaia, Av. João Paulo II, 961, 4410-406, Arcoselo, Vila Nova de Gaia, Portugal
^c Porto Healthcare Unity - Accidents, Fidelity - Insurance Company, Rua Direita de Campús 324, 4100-207, Porto, Portugal
^d IINFACTS - Institute of Research and Advanced Training in Health Sciences and Technologies, Department of Sciences, University Institute of Health Sciences (IUCS), CESPU, GRI, Rua do Paço 5, Penafiel, Gandra, Portugal

ARTICLE INFO

Keywords:
Occupational injury
Professional outcomes
Professional reintegration
Injury assessment
Legal medicine

ABSTRACT

Occupational injuries represent an enormous economic impact for victims, respective families, involved institutions and all the community due to professional outcomes. Thus, it is of the utmost importance that medico-legal personal injury assessment and the posterior follow-up of these victims, may allow their concrete damage repair, considering the victims' needs fulfilment and professional reintegration, whenever possible. The main objective of this study is to reflect on the role that legal medicine can play in promoting the professional reintegration of victims of major occupational accidents through the analysis of occupational injuries cases considering the medico-legal examinations performed. A retrospective study was conducted using medico-legal major occupational injuries cases (*Partial Permanent Disability* ≥ 40%). Data were collected from two medico-legal assessment moments: (a) personal injury assessment homologated by a labour court 4.8 years on average after occupational injury; (b) medico-legal follow-up for needs and/or *Partial Permanent Disability* adjustments performed 18.9 years on average after occupational injury. The final sample includes 103 cases. The results showed that in major occupational accidents, permanent long-term outcomes were principally associated with neurological (62.1%) and orthopaedic (52.4%) sequelae. Permanent professional damage parameters assigned by the labour court included *Partial Permanent Disability* (23.3%), *Permanent Absolute Disability for Regular Work* (41.7%) and *Permanent Absolute Disability for Any Work* (35%). Three-dimensional methodology is helpful in predicting *Partial Permanent Disability* and *Permanent Absolute Disability for Any Work*. However, three-dimensional methodology did not reveal correlations with *Permanent Absolute Disability for Regular Work*, and currently 65% of the victims who were considered able to work by the labour court are not professionally active. Thus, these major cases deserve a more detailed medico-legal approach based on concrete information about the professional reality of each victim, especially cases with an eventual *Permanent Absolute Disability for Regular Work*. Medico-legal Injury Assessment must be based on concrete aspects of the victim's professional reality and not only on permanent disability tables. This calls for an articulation between all institutions working with the victim of occupational injuries and legal medicine to promote recovery and the necessary measures to assure professional rehabilitation.

1. Introduction

Injuries due to occupational accidents constitute a public health, social and economic issue.^{1,2} They are one of the leading causes of premature death, morbidity, and disability in a significant number of persons.^{3,4}

The type and severity of occupational injuries (OI) have been identified as important predictors of trauma outcome.^{5,6} Its impact can be felt at all life dimensions with victims experiencing short- and long-term health consequences that decrease the quality of their life and of their families.^{4,7}

Each year, a total of 374 million nonfatal occupational accidents are estimated to occur worldwide, and the loss of workdays globally represent approximately 4% of the world's gross domestic product.⁸⁻¹⁰

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E-mail address: isabelalmeida@crpg.pt (I. Almeida).

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In 2019, Portugal registered a total of 10,866 occupational accidents that were fatal in 122 cases. The incidence rate of nonfatal accidents was 1,055.4/100,000 workers with temporary consequences requiring work absence in 79,376 cases (73.1%).^{11,12}

Consequences are frequently long lasting and cross cutting several domains of physical and emotional functionality with familial, social, professional, and economical repercussions. Victims frequently report some of the following outcomes^{5,13–16}: (a) high levels of physical changes and pain; (b) high emotional suffering and increased anxiety and depression; (c) reduced capacity to perform daily life activities; (d) increased rates of work absence and unemployment or even of early retirement with decline of productivity and decrease or total loss of income, diminishing financial stability; (e) reduction of life contexts and experiences with social isolation and changes in family roles and dynamics; (f) reduced levels of independence and autonomy, and increased need for health care and third-party assistance. Consequently, professional reintegration (PR) is often compromised.

Return to work and the consequent reintegration effort are often not easy tasks after OI, mostly in major cases. However, this effort represents an important part of the recovery process. Work activity helps to maintain physical conditioning, function, self-confidence and quality of life. Absence from work is associated with poor outcomes, including increased morbidity of several health conditions, as mentioned above.^{17–19}

Thus, it is of the utmost importance that medico-legal intervention, mainly in the scope of insurance medicine, may allow concrete damage repair, considering the victims' satisfaction, including PR, if possible.

Accordingly, to Portuguese labour legislation, the repair of damages and sequelae resulting from an OI, is a right for all workers. Although the responsibility of this damage repair is always in the scope of the employers' responsibility (Law n° 7/2009, December 12th, art. 284°), the legislation offers different configurations, respecting this matter, for public and private sectors of activity. In private sector employers are obligated, by law, to establish contracts with insurance companies for the protecting of their employees in case of OI, transferring the responsibility for damage repair to the insurance companies (Law n° 90/2009, September 4th). For public sector, and for those workers with a public service work contract, although insurance contracts might be celebrated, the responsibility for damage repair is always of the employer, and cannot be transferred for an insurance company (Decree Law n° 503/99, November 20th, art. 4°). In these cases, the damage repair is assured by the National Pension Fund. In both sectors of activity whenever a rate of Permanent Disability is assigned by the insurance company/the national pension fund, or when there is not an attribution of a Permanent Disability and the victim appeals to the labour court because they do not agree with the decision, the public prosecutor of the labour court sends the case to a medico-legal evaluation at the National Institute of Legal Medicine and Forensic Sciences of Portugal. In these cases, the final decision is always of the labour court.

Furthermore, Portuguese legislation on labour accidents considers that all victims have the right to be followed throughout their lifespan by the responsible insurance company services for every needs adjustments (e.g., medical appointments, ancillary exams, medicines, treatments, technical aids, third party assistance), and medico-legal personal injury assessment (IA) revision should be performed once per year when necessary (Law n° 90/2009, September 4th, art. 70°). Thus, medico-legal IA may occur not only at the injury consolidation date but also throughout the victims' lives in a follow-up process, particularly in the major injury cases. To better analyse the outcomes of OI from a medico-legal perspective, the Portuguese IA model may be particularly useful because it offers a detailed and personalized description and quantification of trauma outcomes. Portugal has standardized rules for IA published by the National Institute of Legal Medicine and Forensic Sciences,^{20,21} which are followed by both the public and private sectors (including insurance companies). The comprehensive description of

personal damages is grounded in the *three-dimensional methodology* (3-DM).^{22,23} Based on an ecological model, these 3-DM offer a systematic and validated method to describe and examine trauma outcomes. It considers three levels of damage as follows²³: (a) the *body level*, which assesses biological outcomes with their morphological, anatomical, histological, physiological and genetic particularities; (b) the *capacities level* (functions), which assesses physical and mental capacities (current or potential), taking into consideration the person's age and sex irrespective of the his or her setting of life; and (c) the *life situations level* (participation and activities), which assesses the confrontation (concrete or potential) between the victim and the reality of his or her physical, familial, social, cultural, educational and professional environment.

The main objective of this study is to reflect on the role that legal medicine can play in promoting the PR of victims of major occupational accidents through the analysis of OI cases considering the medico-legal examinations performed. Specific aims are to (a) characterize the mechanisms of trauma and injuries; (b) describe the medico-legal permanent professional damage parameters (PPDP), considering the Portuguese rules on IA; (c) describe the long-term outcomes considering the 3-DM; and (d) analyse which factors are related to PR.

2. Material and methods

A retrospective study was conducted based on a convenience sample constituted by OI cases followed at a Portuguese insurance company, on the northern region of the country.

Study design is presented in Fig. 1, showing that data were collected from two medico-legal assessment moments considering each case: (a) medico-legal PPDP evaluation homologated by a labour court 4.8 years on average after the accident ($SD = 6.8$; range between 10 months and 42.7 years); (b) medico-legal follow-up for 3-DM evaluation and personal needs adjustments performed by the insurance company 18.9 years on average after the accident ($SD = 9.9$; range between 3.2 and 47.9 years). Criteria for case selection were (a) occupational accident occurred between 1970 and 2013, assuring a length of time between the accident and the medico-legal follow-up ≥ 3 years to allow professional condition stabilization; (b) *Permanent Partial Disability* homologated by a labour court $\geq 40\%$ (assessed by the *Portuguese National Permanent Disability Table – Annex 1 of the Decree-Law n° 352/2007, of October 23rd*), assuming that PR is particularly difficult in major OI; and (c) last medico-legal follow-up report performed between 2016 and 2018 under a uniform protocol and by the same physician with extensive experience with the Portuguese medico-legal methodology to assure data reliability. A total of 103 cases were selected.

For cases that fulfilled these criteria, an anonymous database elaborated by the physician who conducted the medico-legal follow-up was provided.

The *Injury Severity Scale* (ISS) was retrospectively estimated for the purposes of this study based on injury descriptions in the acute phase in the available clinical files. The results were grouped into the following categories^{24,25}: (a) 0 (nonexistent), (b) 1–8 (minor or moderate), (c) 9–15 (serious), (d) 16–24 (severe), and (e) ≥ 25 (critical).

The PPDP considered in Portuguese Labour Law are noted as follows²³:

- Permanent Partial Disability* (PPD), assigned when there is a functional affectionation with repercussions in the victim's earning capacity (n°1 of General Instructions of Annex 1 of the Decree-Law 352/2007, of October 23rd); this may be associated with a physical and/or functional outcome, demanding additional efforts to perform regular work or even the need for workplace adaptation and/or the use of technical aids;
- PPD + *Permanent Absolute Disability for Regular Work* (PAD-RW), assigned when the victim presents total disability for a work in the scope of his or her technico-professional qualifications with the need for professional reconversion;

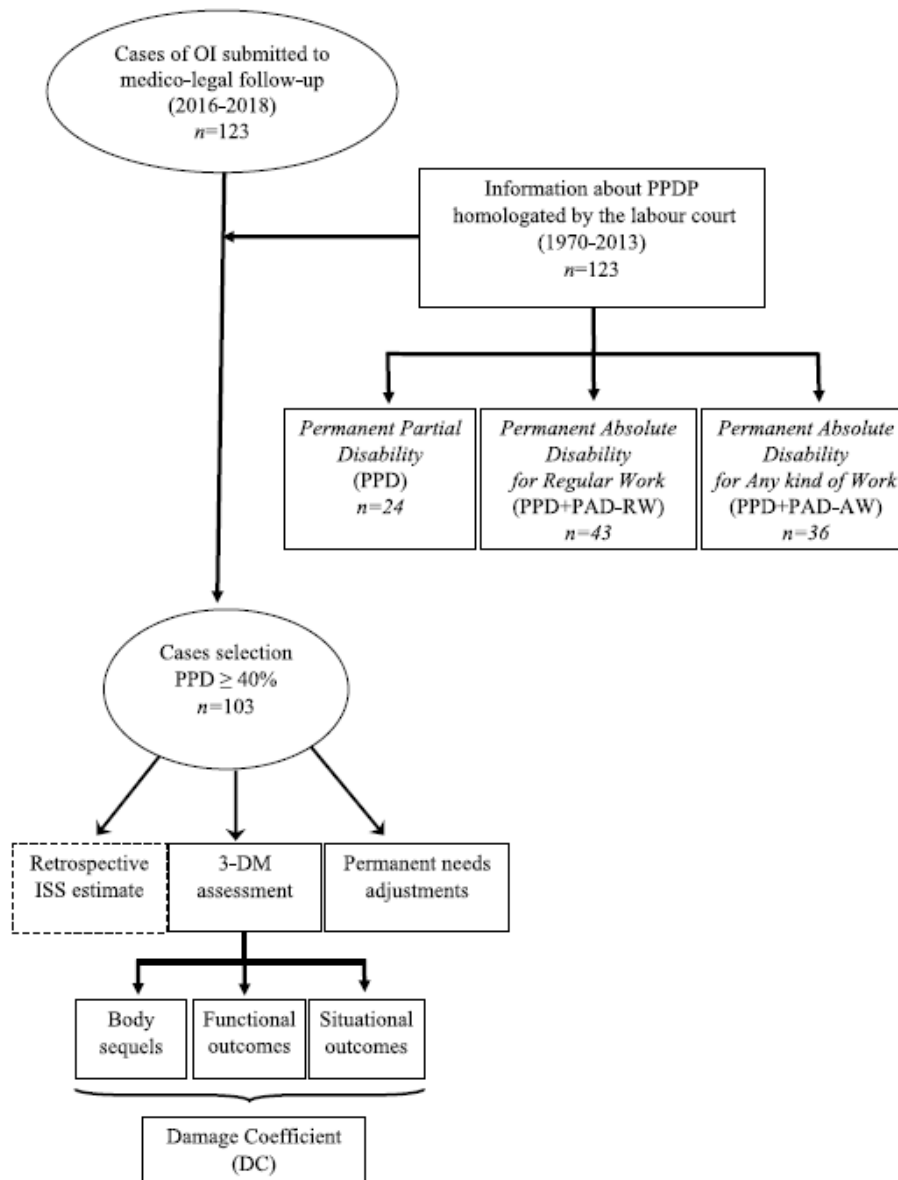


Fig. 1. Study design.

- c) PPD + Permanent Absolute Disability for Any Work (PAD-AW), considered in cases of total disability for any type of work without professional reconversion capacity;
- d) Permanent Needs, categorised accordingly to several dimensions identified in the literature and clinical practice²³ (Table 4).

Considering the 3-DM, the *Inventory for Handicap Assessment* was used to describe permanent outcomes and to calculate the Damage

Coefficient (DC).²² This coefficient score corresponds to the average of the severity degree of body, functional and situational levels. The result is a 5-level final score²²: (a) 0 - independent; (b) 1 - independent, but with difficulties; (c) 2 - dependent of medicines and/or technical aids; (d) 3 - partially dependent of third-party assistance (autonomy partially affected); (e) 4 - completely dependent of third-party assistance (without autonomy).

Regarding the concepts of PR and professional reconversion, for the

purposes of this study, and considering Portuguese legislation, the following was assumed:

- Professional reintegration or work recovery* means the worker reintegrating in the exercise of a profession (the same as the previous one, or another). In Portugal, in OI cases, this reintegration presupposes the obligation on the part of the employer to ensure that the worker who has suffered an accident at his or her service is occupied in functions compatible with the limitations resulting from the accident (Law n° 98/2009, of September 4th, art. 155°, n° 1). Implicit here, therefore, is the notion of remaining capacity and the importance of addressing this aspect in medicolegal terms, considering the rehabilitation and reintegration possibilities;
- Professional reconversion* corresponds to the requalification and reintegration of a worker in an activity that requires a different technical-professional qualification/competence from his or her previous one, taking into account the remaining capacity, school and professional qualifications, age, and possible needs in terms of adapting to the new workplace, technical aids and professional training.

All analyses were performed using SPSS for Windows (IBM SPSS Statistics, Version 25.0). Descriptive statistics were conducted to analyze the victims' demographics, trauma characteristics and permanent outcomes. The *chi-square test* and *Spearman correlations* were applied to assess the relation between variables of interest. Correlation analyses were performed between the outcomes assessed at the medico-legal follow-up (body, functional, situational and Damage Coefficient severity degrees), the work-related outcomes (unemployment, early retirement, professional reconversion), and the medico-legal PPDP homologated at a labour court (PPD, PPD + PAD-RW, and PPD + PAD-AW). Correlation analyses were also performed among PR dimensions (professional reconversion, unemployment, and early retirement), the medico-legal PPDP (PPD, PPD + PAD-RW, PPD + PAD-AW), and the ISS as well as the victim's sex and age, using univariate analysis. In all analyses, the level of statistical significance was set at a *p* value of <.05.

The study protocol was approved by the Ethics Committee for Health of Centro Hospitalar de São João/Faculty of Medicine, University of Porto, Porto. All guarantees of anonymity given were honoured.

3. Results

3.1. Victims' demographic characterisation

Most of the participants were male ($n = 91$; 88.3%). At the time of the accident, the mean age was 35.8 years old ($SD = 10.8$; $Min = 16$; $Max = 59$), and 62.1% were between 25 and 45. Most worked in secondary ($n = 56$; 54.4%) or tertiary sectors ($n = 43$; 41.7%). Construction workers ($n = 44$; 42.7%), operators of plants and machinery ($n = 26$; 25.2%), and general services and trade personnel ($n = 13$; 12.6%) were the most common occupations involved.

At the time of the medico-legal follow-up, the mean age was 54.3 years old ($SD = 10.9$; $Min = 23$; $Max = 81$).

3.2. Trauma mechanism and injury characterisation

Different mechanisms of trauma, injury location and injury severity grades are described in Table 1. The ISS was 23.9 on average ($SD = 10.3$; $Min = 3$; $Max = 57$). One of the victims had no physical injuries, but the OI was a psychiatric disorder due to a violent road-traffic accident experience with a great negative impact on his capacity to perform daily life activities.

3.3. Three-dimensional description of permanent outcomes

At the medico-legal follow-up, most of the victims ($n = 66$; 64.1%)

Table 1

Occupational injury mechanism, severity, and body location ($n = 103$).

		n (%)
Injury mechanism	Fall from elevation	42 (40.7)
	Road traffic accident (in itinere)	32 (31.1)
	Hit by an object	17 (16.5)
	Burn (chemical, electric, explosive, or thermal)	9 (8.6)
	Crush	3 (2.9)
ISS grade	Critical (≥ 25)	57 (55.3)
	Severe (16–24)	35 (34)
	Serious (9–15)	8 (7.8)
	Nonexisting or minor/moderate (1–8)	3 (2.9)
Injury location ^a	Cranium/brain and/or rachis/spinal cord	76 (73.8)
	Face and/or neck	25 (24.3)
	Chest and/or abdomen	36 (34.9)
	Upper and/or lower limbs	53 (51.5)
	Nonexistent	1 (1)

Medico-legal permanent professional damage parameters.

The PPDP homologated by the labour court are described in Table 2. The PPD mean rate for the total sample was 75.4% ($SD = 18.5$; $Min = 40$; $Max = 100$).

^a Injury location categories are not mutually exclusive.

Table 2

Professional permanent damage parameters ($n = 103$).

PPDP	n (%)	PPD (%)	
		Mean (SD)	Min/Max
PPD	24 (23.3)	57.7 (8.4)	41.8/76
PPD + PAD-RW	43 (41.7)	69.1 (12.7)	43.0/90.6
PPD + PAD-AW	36 (35)	94.3 (11.3)	52.5/100

presented sequelae in two or more body regions (mainly neurological), and mostly had functional repercussions at mobility and pain, as well as professional repercussions (Table 3). Outcome severity assessed by the

Table 3

Typology of body, functional and situational permanent outcomes ($n = 103$).

Outcome levels	Outcome types	n (%)
Body ^a	Neurologic	64 (62.1)
	Orthopaedic	54 (52.4)
	Psychiatric	45 (43.7)
	Dysmorphic	43 (41.7)
	Nephrologic/Urologic	36 (35)
	Ophthalmologic	25 (24.3)
	Reproductive	23 (22.3)
	Otorhinolaryngologic	20 (19.4)
	Dermatologic	19 (18.4)
	Gastroenterologic	14 (13.6)
	Stomatologic	10 (9.7)
	Pneumologic	3 (2.9)
Functions ^a	Carriage, displacement, and transfer	81 (78.6)
	Pain	81 (78.6)
	Affectivity	67 (65.0)
	Sexuality and/or procreation	51 (49.5)
	Cognition	45 (43.7)
	Senses	42 (40.8)
	Sphincter control	42 (40.8)
	Manipulation and grip	33 (32.0)
	Adaptation to efforts	24 (23.3)
	Weight change	21 (20.4)
	Mastication and ingestion	16 (15.5)
	Communication	15 (14.6)
	Consciousness	13 (12.6)
	Others	5 (4.9)
Situations ^a	Professional life	90 (87.4)
	Acts of daily living	72 (69.9)
	Other activities (leisure, social, sportive, affective)	69 (67)

^a Three-dimensional outcome categories are not mutually exclusive.

3-DM is presented in Table 4.

Detailed information about current *Permanent Needs*, and *Third-party assistance* typology is described in Table 5. Almost all participants ($n = 102$; 99%) presented permanent needs in two or more areas of assistance, mostly medical appointments, medication, and ancillary exams.

Current professional status is described in Table 6, considering the total sample and the PPDP previously attributed.

3.3.1. Correlations

Correlations, as described in Table 7, were found between the following:

- PPDP (except PAD-RW) and 3-DM levels + DC;
- PPDP and all PR variables;
- 3-DM levels + DC, and early retirement;
- 3-DM situations level + DC, and professional reconversion.

4. Discussion

4.1. About the selected sample

The studied sample characteristics are in accordance with the Portuguese official statistics¹² and literature concerning major occupational accidents.^{26–31}

Major OI in Portugal is more frequent among young males (aged between 25 and 45 years old), as described in other series.^{26,32–36} This fact is of concern because the affectation of the professional active life will be longer than it would be in cases of people near retirement. This finding further highlights the importance of a great investment in PR.

The secondary and tertiary sectors of activity are the most affected

Table 5

Permanent Needs and Third-party Assistance typologies (n = 103).

	n (%)
<i>Permanent needs typology*</i>	Regular medical appointments
	Medication
	Regular ancillary exams
	Regular treatments
	Special transportation
	Third-party assistance
	Technical aids (including animal aid)
	Medical supplies
	Home adaptations
	Prostheses
	Orthoses
	Vehicle adaptation
	Adapted sport
<i>Third-party assistance typology</i>	Total assistance (grade 4)
	Partial assistance (grade 3)
	Stimulation or supervision (grade 2)
	Vigilance (grade 1)

* The needs typologies are not mutually exclusive.

Table 6

Current professional situation at the time of the follow-up – n (%).

	Total	PPD	PPD + PAD-RW	PPD + PAD-AW
Earlier retirement	40 (38.8)	2 (8.3)	2 (4.7)	36 (100)
Unemployment	32 (31.1)	6 (25)	26 (60.5)	–
Prof. reconversion	25 (24.3)	10 (41.7)	15 (34.8)	–
Previous job	6 (5.8)	6 (25)	–	–
Total	103 (100)	24 (100)	43 (100)	36 (100)

(96.1%). The manufacturing industry and construction are the professional activities with the highest incidence of accidents. Considering that work physical demands impose more risks,^{26,27,33,36–40} the issue of prevention is fundamental here.

The most common mechanisms of general OI are slipping, getting hit by unsharp or sharp objects, being caught in machinery, and falling from heights.^{33,40–43} However, our sample only includes major OI. In these cases, falls from elevation and road traffic accidents are the most frequent mechanisms,^{37,42} representing, conjunctly, 71.8% of the cases in this study.

Additionally, in general OI, injuries are mainly orthopaedic in the lower and upper limbs.^{12,33,35,41,44,45} However, in major cases, most injuries are neurological,^{28,46} as observed in our data (62.1%), whereas only 52.4% are orthopaedic (Table 3). One of the victims had no physical injuries but a psychiatric disorder related to the traumatic experience – a road traffic accident with car incarceration. The existence of psychological trauma in several occupational accidents emphasizes the importance of early psychological and, occasionally, psychiatric treatment in these cases given that the psychological conditions may be prevented. Furthermore, posttraumatic stress disorder, anxiety and depression, among other mental conditions, are linked to more days of work absence, failure to maintain one's job, and poor outcomes concerning return to work.^{5,13,16,47,48}

Table 4
Severity of body, functional and situational outcomes (n = 103).

Dimensions	Score	n (%)
<i>Body</i>	0 - Nonexistent	1 (1)
	1 - Minimal	4 (3.9)
	2 - Mild	42 (40.8)
	3 - Important	39 (37.9)
	4 - Severe	17 (16.5)
<i>Functions</i>	0 - Without difficulty	0 (0)
	1 - Minimum difficulties (slowness and/or discomfort)	14 (13.6)
	2 - Medium difficulties (medicines and/or technical aids)	59 (57.3)
	3 - Important difficulties (partial third-party assistance)	19 (18.4)
	4 - Impossible (total third-party assistance)	11 (10.7)
<i>Situations</i>	0 - Without difficulty	0 (0)
	1 - Minimum difficulties (slowness and/or discomfort)	21 (20.4)
	2 - Medium difficulties (medicines and/or technical aids)	32 (31.1)
	3 - Important difficulties (partial third-party assistance)	39 (37.8)
	4 - Impossible (total third-party assistance)	11 (10.7)
<i>Damage Coefficient</i>	0 - Independent	0 (0)
	1 - Independent but with difficulties	14 (13.6)
	2 - Dependent of medicines and/or technical aids	39 (37.9)
	3 - Partially dependent of third-party assistance	39 (37.8)
	4 - Completely dependent of third-party assistance	11 (10.7)

Table 7
Study correlations (n = 103).

		PPDP (4.8 years after OI)						Current professional outcomes (18.9 years after OI)					
		PPD		PAD-RW		PAD-AW		Unemployment		Early retirement		Professional reconversion	
		ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p	ρ/χ^2 (df)	p
Victims'	sex	-.14	.14	-.03	.78	.08	.45	-.07	.49	.02	.82	-.04	.68
	age	52.6 (63)	.82	.4 (1)	.53	.27 (1)	.60	.3 (1)	.58	.13 (1)	.72	.4 (1)	.51
ISS		.12	.24	.08	.44	-.11	.28	0.03	.74	-.03	.75	-.06	.56
Body		.52	<.001**	2.9 (4)	.58	26.1 (4)	<.001**	8.9 (4)	.06	19.4 (4)	<.001**	0.4 (4)	.98
Functions		.43	<.001**	5.5 (3)	.14	24.9 (3)	<.001**	4.0 (3)	.26	23.8 (3)	<.001**	6.4	.09
Situations		.43	<.001**	6.9 (3)	.07	29.4 (3)	<.001**	3.8 (3)	.28	35.2 (3)	<.001**	19.2 (3)	<.001**
Damage Coeff.		.46	<.001**	7.4 (3)	.06	29.7 (3)	<.001**	3.5 (3)	.32	35.1 (3)	<.001**	17.9 (3)	<.001**
Unemployment		.25	.01*	27.4 (1)	<.001**	21.8 (1)	<.001**						
Early retirement		-.64	<.001**	32.9 (1)	<.001**	78.7 (1)	<.001**						
Prof. reconver.		.35	<.001**	13.9 (1)	<.001**	n.a.	n.a.						

* Significant at $p < .05$; ** significant at $p < .001$.

In 89.3%, ISS presented a score ≥ 16 (severe or critical), but no correlation was found between ISS and medico-legal PPDP, PR variables or personal variables. The absence of correlations can indicate a good clinical evolution of the cases, which is favoured because it is a young population. Nevertheless, injury severity is considered a major predictor of work disability,^{3,29-31,49} and the literature notes that males are more likely to present multiple and severe injuries than females, which results in higher levels of disability.^{26,32}

4.1.1. Medico-legal PPDP

Major OI is always associated with some degree of temporary and permanent professional disability. Variables, such as age, injury severity, previous occupation, work absence period and financial compensation system, have been reported as factors related to OI long-term outcomes.^{48,50-52}

Temporary professional outcomes in Portuguese legislation (*Absolute Temporary Disability* and *Partial Temporary Disability*) were not considered for this study given that it focused exclusively on permanent outcomes. However, the period of recovery is of utmost relevance because the length of temporary disability and the early PR are important predictors of permanent outcomes and good indicators of the ability to return to work.^{49,53} Furthermore, being professionally integrated is extremely important for recovery and perceived health status, preventing the emergence of psychological problems, such as depression; therefore, it is a major contribution to improving economic status and increasing sense of utility, social participation, quality of life, and well-being.^{16,54,55} Victims referred to services specialized in rehabilitation focused on promoting return to work have better chances of PR either at previous or new occupations. The absence of an early involvement of a rehabilitation and a PR team working closely with the victim can negatively influence not only the length of time that mediates return to work but also the professional permanent outcome, especially in more severe cases and/or whenever financial compensation is at stake.^{53,56,57} Thus, this aspect is of great concern and deserves to be analysed.

The PPDP observed in this study was homologated by a labour court 4.8 years, on average, after the OI. According to Portuguese Labour Law (Law n° 98/2009, September 4th), there are two possibilities considering permanent disability assignment (Fig. 1):

- Persons without PPDP:* injuries cure or consolidate without functional outcomes that may cause professional repercussions with loss of income. In our study, these cases are not represented because a PPDP $\geq 40\%$ was assumed as an inclusion criterion;
- Persons with PPDP:* when injuries consolidate with functional outcomes causing professional repercussions.

In conformity with the same Law, when a PPDP is assigned, there are three possibilities of medico-legal conclusion, as described in Fig. 1:

- Persons with PPDP:* The victim is clinically considered capable of maintaining his or her usual work or other similar work in the area of his or her technico-professional qualification/competence. This, despite the work, may require increased efforts, some eventual work place adaptation or even the use of technical aids. In these cases, a loss of gain capacity is assumed. In our study, PPDP was assigned in 23.3% of the cases with a mean rate of 57.7%, which is higher than PPDP $\geq 40\%$ the criteria for major accidents. Despite that in Portugal small rates of PPDP (e.g., 1%–3%) continue to be noted simply because the specific body sequelae are referred to in the *Portuguese National Permanent Disability Table*, even if there are no functional or professional repercussions that advise it and, therefore, on the contrary provided by law;
- Persons with PPDP + PAD-RW:* The victim is not considered able to maintain his or her regular work or other in the area of his or her technico-professional qualification/competence, being a professional reconversion possible, considering the victim's sequelae, remaining capacity, qualifications and age, among others. In our study, this status was assigned in 41.7% of the cases (PPD mean = 69.1%). The PPDP rate was higher than that found in PPDP isolated cases (57.7%). These differences result from the high degree of severity of the outcomes of the cases. However, although, in general, the frequency of annual cases in Portugal is only slightly higher than 1%, all the commitment to PR remains very important given that a large number of young people can return to an active professional life with support despite the sequelae;
- Persons with PPDP + PAD-AW:* The victim is considered completely unable to perform any type of work. In our study, it was assigned in 35% of the cases (PPD mean = 94.3%). Although the frequency of this cases is normally low, it represents a high rate of young people who are left without any work capacity, and it is especially important here to rethink PR issues, remaining attentive to the evolution of the rehabilitation and reintegration processes, which can bring new solutions for these persons.

4.2. Three-dimensional permanent outcomes

The 3-DM medico-legal analysis was performed 18.9 years on average after OI.

The current body severity level was important or severe in 54.4% of the cases (Table 3), although the ISS score was assessed as critical or severe in 89.3% (Table 1). This finding may signify a positive evolution of the more serious cases after clinical and rehabilitation care, and over time, emphasizing the importance of rehabilitation and PR in the OI recovery process.⁵³ Due to injury typology (Table 1), body sequelae were mostly neurological (62.1%), but orthopaedics were also present in more than half of the cases (52.4%) (Table 3). This finding was expected in trauma mainly resulting from falls from elevation^{58,59} and traffic accidents.^{60,61}

Current functional outcomes (Table 3) reflected mostly on carriage, displacement, and transfer (78.6%); experiencing pain (78.6%); and affectivity (65%).

Current situational outcomes (Table 3) were present in the three levels of life considered, but professional life was the most affected (87.4%). The presence of long-term problems of pain, discomfort and mobility have been reported as prevalent outcomes for severely injured workers, even several years after the event,^{48,62} which is precisely what we observed although some evolution was also detected. Professional inactivity as a result of OI outcomes was noted in 69.9% of the victims ($n = 72$) due to unemployment or early retirement (Table 6), which appears to be a high rate, even for major cases.^{12,63}

Long-term permanent consequences of OI, such as those present in our sample cases, often reflect on increased permanent needs, and those have been identified as indicators of failure of PR.^{49,64} Almost all victims have some type of permanent need (99%), and approximately half of them require third-party assistance (48.5%) (Table 5). The dependence of third-party assistance to perform daily life activities increases in the same direction of body sequelae severity and has an important negative impact on PR.^{15,48,54,55,65}

A correlation between age and body severity was found ($\rho = -0.25$; $p = .01$), verifying that younger victims present less severe body damage outcomes. The mean age of the victims in our study was 35.8 years at the time of the accident, which might account for this result given that the literature reports that younger age is a protective factor for work capacity.^{66,67} Older victims tend to recover poorly given that more health comorbidities, more physical and functional decline, and less capacity to recover after injury are present. As a result, after OI, older victims tend to have longer periods of recovery, constituting longer periods of work absence, and are more likely to maintain long-lasting outcomes due to health comorbidities and the ageing process.^{66,67} Nevertheless, some discrepancies can be found in the literature regarding the influence of age on work capacity. Studies comparing OI outcomes in younger and older workers observed no relation between age and professional capacity outcomes.^{34,68}

4.3. Professional outcomes

According to the initial IA, 65% of the victims were considered able to maintain a professional occupation ($n = 67$). However, greater than half did not work at the date of the follow-up due to unemployment or early retirement as a consequence of OI (Fig. 2).

In the cases assigned with PPD, 33.3% of the victims were not professionally reintegrated (Table 6), which may be due to the various circumstances discussed below. Regarding the cases of PAD-RW, the expected PR was only accomplished in 34.9% (Table 6). These results reflect an important failure on the PR, especially with regard to professional reconversion in cases of PAD-RW, which deserves more detailed studies.

Evidently, these are cases that have evolved for a long time, and at the time of the accident, the solutions to promote reintegration would not be as developed and available as at the present moment. Currently, this topic is still complex, and we know that several factors can explain the difficulty in PR, including the following:

- Personal factors:** Some examples are the lack of motivation for work, the lack of tolerance for pain or other functional limitations, the feeling of lack of strength, the feeling of discomfort when confronting coworkers and supervisors, the lack of educational qualifications and/or professional skills to be integrated into another professional activity or even the high age, preferring to retire, albeit relatively early. In fact, self-perceived health is of extreme importance for PR as well as good physical and psychological health.^{69,70} Furthermore, neurologic sequelae (the most frequent in these major OIs) as well as orthopaedic sequelae are considered predictors for more difficulties in professional performance.^{28,71,72} Psychiatric sequelae, which was noted in 43.7% of our sample (Table 3), are related to a decrease in work capacity, with the literature showing that posttraumatic stress disorder, depression and anxiety are associated with higher rates of professional disability.^{15,16,54,73}
- Environmental factors (social, familiar and professional):** Social and familiar support are fundamental for PR.^{69,70} Additionally, workplace accommodations, peer support in the workplace, and flexibility to adjust job responsibilities and schedules to accommodate individuals' functionality have been identified as good predictors of successful return to work.¹⁷
- Access to professional rehabilitation services:** Early access to these services is crucial to promote successful return to work. However, this occasionally does not occur as precocious as it should due to financial compensation systems and the long duration of legal processes, compromising victims' PR.^{48-52,54-56}
- Financial compensation process:** Workers under financial compensation processes after OI show slower rates of recovery and longer periods of work absence, suggesting a negative influence of legal processes on professional outcomes.^{48,57,74} Furthermore, financial compensation is directly indexed to permanent disabilities, which can constitute a barrier for victims' engagement and/or referral for PR until PDPD homologation.^{56,57}

PR may be compromised not only by one but also by several of these factors, making return to work even more difficult. Personal and social aspects, such as motivation, resilience, social and familiar support, and financial stability, are important predictors of functional and situational outcomes, including PR.^{49,75} The adjustment to the consequences of OI involves mechanisms of cognitive, emotional and behavioural adaptation to cope with the functional and situational outcomes of the accident. This adjustment can be promoted in cooperation with the medico-legal units of insurance companies, as we will discuss below.

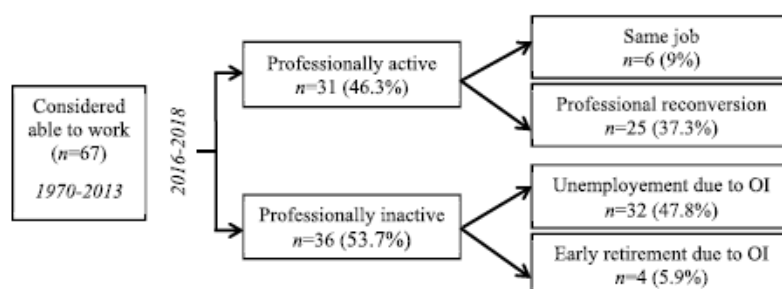


Fig. 2. Professional outcome.

4.4. Contribution of the medico-legal IA for PR

Work is an essential dimension of life, ensuring financial stability, social status, a sense of self-confidence, and providing physical and intellectual activity as well as social interaction, which prevent psychosocial isolation and promote emotional stability.^{16,54,55,76} Work absence, especially if prolonged, and the late start of PR can lead to increased morbidity and health comorbidities, including psychological problems (e.g., depression and anxiety), reduce functional independence and social isolation with a reduction in life settings and life experiences, as well as tremendous effects on the ability to perform professionally and, consequently, prompting financial problems.^{49,76} All these factors can, and often do, increase the costs of workers' legal compensation.^{17,48} Return to work is therefore an important aspect of the OI recovery process, as it can constitute a milestone of restoring a sense of competence and normality in victims and their family's life.^{16,54,55,70} Thus, early PR in the same occupation or in another adjusted to victims' current functionality is fundamental because it provides (a) context in which coping skills to deal with disabilities can be learned and trained;^{17,69} (b) physical conditioning and functionality improvements;^{17,69} (c) a sense of self-efficacy recapture, allowing the victim to recover self-confidence in his or her abilities and capacities, helping the maintenance of professional activity in the long term;^{49,53,69} (d) a sense of utility and identity associated with respect and social recognition, increasing social support and contacts, which are extremely important at reducing the risk of depressive and anxious symptoms;^{70,77} and (e) improved quality of life.^{17,69}

Efforts at minimizing prolonged work absence and promoting early and adjusted PR require the participation of several professionals of insurance medicine (e.g., medical assistance providers, rehabilitation, psychological and social worker professionals) and occupational medicine, employers, and victims and their families.⁷⁸ The early engagement of these multidisciplinary teams has been evidenced as an important predictor of good professional outcome and therefore must be reinforced.^{29,31,53,56,57}

According to our experience, we consider that the articulation of the medico-legal experts, especially from the insurance companies, with these multidisciplinary teams would be very useful in some cases to avoid some negative results, as we found in the present study. Despite having found high correlations between the PPDP and the PR variables (Table 7), suggesting that PPDP are a good measure of the victims' work capacity, we found that after a length of time of 18.9 years, on average, 65% of the victims who were considered able to work by the medico-legal experts (with the labour court homologation) were not professionally active (Fig. 2). This finding leads us to question whether the problem is related to (1) the multiplicity of factors that could explain the difficulties in return to work, or even the no return, above referred^{15-17,28,48-50,53,55,70,72,74}; (2) the absence of an adequate PR plan before the medical discharge and the medico-legal IA; and (3) the medico-legal IA, which is many times out of step with the real job context of the victim. Most likely, all these aspects are involved in the final result. However, legal medicine cannot exempt itself from its responsibilities, and it is important that it is open to new and better methods of evaluating these cases, mainly the cases that may be assigned as PAD-RW.

In Portugal, PPDP assessment is very relevant and mandatory by law. However, in the majority of cases, PPDP evaluation relies exclusively on the *National Permanent Disability Table* and only considering the body sequelae. This type of procedure may explain, at least, part of the obtained results (mainly in the cases assigned as PAD-RW). In fact, each person represents a particular reality where the body is just one part to be assessed. The different contexts of life of each person (environmental factors, as proposed by the International Classification of Functioning, Disability and Health⁷⁹) must also be considered in the evaluation.²² In the special cases of OI, all the aspects that are work-related need to be taken into consideration with great care and attention. These aspects

were not considered in the cases assessed between 1970 and 2013, particularly the oldest ones. Thus, we believe that we could have found a better agreement between this assessment and the professional victims' situation between 2016 and 2018.

This articulation of the medico-legal expert with the PR team may be very important at promoting the victims PR given the following reasons:

- Often, in cases that arrive at IA without any attempt to return to work, there may be scope to promote a last PR attempt through articulation with a PR team. For that purpose, we may consider that 3-DM evaluation provides a consistent, comprehensive and integrated view of the accident outcomes and permanent needs that can be very informative about professional capacity and/or the need for PR. Thus, it should always be considered part of the evaluation, allowing the expert to discuss in detail with the victim about his or her professional activities and proposing solutions that can be tried in the context of an attempt at PR, considering the functional limitations observed at the IA. This will be particularly important in cases of PAD-RW, which are the most complex and, as shown in this study, did not correlate with 3-DM (Table 7). Furthermore, the detailed description of the person and the interaction of his or her capacities/ functionality in different contexts is an excellent tool for communication and articulation between all parts: medico-legal experts, professionals of rehabilitation and reintegration, occupational physicians, workplace advisors, insurance companies and even labour courts. This methodology should comprise the first medico-legal IA as well as the subsequent follow-up;
- Experts have long experience and specialized methodologies that can assist in the detection of simulation or exaggeration of OI damages due to expectation of higher financial indemnity.^{64,74} The value of financial reparation is often related to the degree of disability presented by the victim and its inability to perform a professional duty that assures financial incomes; therefore, some victims might show some resistance in being reconverted or reintegrated before the closure of legal processes, losing the benefits of an early PR for the health and recovery process.^{16,54,55} In fact, an increased risk of negative outcomes has been reported when financial compensation of OI resulting sequelae is at stake.^{48,56,57,74}
- Medico-legal follow-up of the major OI victims by the medico-legal staff of the insurance companies, as established by Portuguese legislation (Law n° 98/2009, September 4th, art. 70°), is an important measure to accompany victims throughout their lives, especially in the first years after the accident: (1) assisting recovery and establishing the path towards reintegration; (2) assessing the long-term outcomes; (3) recognizing and responding to the required assistance to cope and deal with them; and (4) informing and promoting PR.

In those cases, the challenge needs to be faced with a multidisciplinary team of service providers and medico-legal staff, where insurance companies, vocational rehabilitation centres, occupational medicine, and companies must work in a joint, structured, and integrated manner to support the effective PR of the victims.

4.5. Limitations of the study and further studies

The small sample size and the methodological limitations inherent to a retrospective study design constitute the limitations of the study. Furthermore, some variables that have been established to be related to PR^{34,48,60,74} and that could assist us in a better understanding of the results, such as education level, socioeconomic status, psychosocial indicators, psychological status, job demands, professional rehabilitation, and social support, were not collected. Given the retrospective nature of the study, we only used available information. Information related to other follow-up assessments of each case as well as of rehabilitation interventions that have eventually occurred in this gap of 18.9 years

could also have guided us to better understand the victim's evolution regarding their sequelae.

To better understand OI outcomes and to find solutions aiming for better results in PR, namely, those involving the early intervention of multidisciplinary PR teams, including the medico-legal expert, further studies concerning the relation of emotional, psychosocial and social factors and PR, temporary professional disability, and professional reconversion in cases of PAD-RW are needed.

5. Conclusions

According to our sample, in major occupational accidents:

- Victims were mostly men (88.3%), those aged between 25 and 45 (62.1%), and secondary and tertiary sector workers (96.1%);
- Falls from elevations and road traffic accidents were the principal injury mechanism with most of the injuries located at the brain and spinal cord (73.8%) with an ISS score of severe or critical (89.3%);
- Permanent long-term outcomes were principally associated with neurological (62.1%) and orthopaedic (52.4%) sequelae;
- The global PPD mean was of 75.4% (Min = 40%; Max = 100%);
- Considering the PPDP homologated at a labour court 4.8 years, on average, after the accident, cases were assigned to PPD (23.3%), PAD-RW (41.7%) and PAD-AW (35%), presenting mean rates of 57.7%, 69.1% and 94.3%, respectively;
- Considering 3-DM assessed 18.9 years, on average, after the accident, 48.5% of the victims presented a DC in levels 3 and 4 of severity at the follow-up exam with 99% having permanent needs;
- 3-DM is helpful for predicting PPD and PAD-AW;
- 3-DM did not reveal correlations with PAD-RW, and currently 65% of the victims who were considered able to work by the labour court are not professionally active. Thus, these major cases deserve a more detailed medico-legal approach based on concrete information about the professional reality of each victim.

Medico-legal IA must be based on concrete aspects of the victim's professional reality and not only on permanent disability tables. This calls for an articulation between all institutions working with victims of OI, including medico-legal experts of the insurance companies, to promote recovery and the necessary measures to assure the PR in the same or in other professional activity according to the victim's remaining physical and psychological capacity and his or her previous skills.

Ethics approval

The present study was approved by the Ethics Committee for Health do Centro Hospitalar São João/Faculty of Medicine, University of Porto. Guarantees of anonymity given to research participants, professionals and institutions were honoured.

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Consent to participate

Not applicable.

Declaration of competing interest

All the authors declare that they have no conflicts of interest.

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Corrigendum to “The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution” [J. Forensic Leg. Med. 90 (2022) 1–10/102391]

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The authors regret that the data reported in the article introduction, relating to 2019 Portuguese occupational accidents, weren't accurate. In 2019, Portugal registered a total of 196.202 occupational accidents that were fatal in 104 cases. The incidence rate of nonfatal accidents was

4.105,7/100.000 workers with temporary consequences requiring work absence in 138.813 cases (70.8%).

The authors would like to apologise for any inconvenience caused.

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5. Appendix E: Study 2 – Published paper

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Research Article

Relationship between psychological symptoms and professional reintegration after an occupational accident: a Portuguese cross-sectional forensic study

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Abstract

Occupational accidents (OAs) are stressful life events with the potential to trigger temporary or long-lasting psychological symptoms that can affect the capacity to resume work and/or the extent of permanent professional disability (PD). This study aimed to analyze the relationship between psychological symptoms reported at the end of the OA recovery and rehabilitation process and both professional reintegration and PD. A cross-sectional study using a convenience sample ($n = 101$) was conducted over a 6-month time span at a Portuguese insurance company after the medico-legal examination. The participants underwent a semi-structured interview and completed self-reported psychological measures. Information regarding current professional status (active vs. inactive) and the assignment of a PD rate (with vs. without) was collected. Most of the participants (80.2%) were already professionally active, and 54.5% were assigned a PD. With respect to the psychological measures, the participants reported a moderate or above level of self-perceived in the following: emotional pain (71.3%), difficulties at work and social adjustment (WSA) (61.4%), anxiety (40.6%), and depression (35.6%). Reported symptoms of depression and WSA difficulties were greater in the professionally inactive group and were correlated with professional status. Reported symptoms of WSA difficulties were shown to be good predictors of professional status. The PD-assigned group presented higher WSA difficulty levels and was a good predictor of PD attribution. The findings shed light on the potential impact of reported depression symptoms and WSA difficulties on professional reintegration, stressing the importance of psychological assessment and support (when needed) during recovery and professional rehabilitation processes.

Key points

- Occupational accidents are stressful life events with the potential to trigger psychological symptoms.
- This study showed that psychological statuses, especially depression and work and social adjustment difficulties, can affect professional status and professional disability.
- Psychological assessment of injured workers, during recovery and professional rehabilitation phases, is important to provide (when needed) psychological treatment to enhance the odds of recovery and of successful return to work.

Keywords: forensic sciences; occupational accident; psychological symptoms; professional outcomes; medico-legal outcomes; professional rehabilitation; professional reintegration

Introduction

Regardless of each country's legislation, occupational accidents (OAs) correspond, in clinical terms, to traumatic events that occur in a sudden and unforeseen manner, are of external origin to the constitution of the victim, and are related to work. These events result in acute injuries to physical and/or mental integrity with the potential to cause death or functional sequelae that can permanently affect an individual's physical and psychological health and well-being [1–3].

OAs are a global cause of death, morbidity and disability with enormous personal, social and economic impacts [4–8]. One of these negative impacts is related to the repercussions of

permanent physical outcomes in professional reintegration [9]. However, it is also important to consider the impact of psychological symptoms that can emerge after OA because they can be equally disabling [10–12].

Adapting to these short- or medium-term personal and professional changes requires physical, cognitive, emotional, and behavioural adjustments, which can affect the recovery process and the psychological stability of injured workers [13–17]. These stressful and potentially traumatic events can, among other things, trigger changes in workers' thoughts and feelings about themselves and about the world around them, leading to psychological mechanisms such as catastrophizing, helplessness, perceived injustice and

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disability, rumination, demotivation, altered perceptions of personal capacities and a reduced sense of control, all of which are cognitive and emotional processes known to be linked to poorer mental health [18–22]. All these changes can lead to reduced functional capacity, which may delay or even prevent a successful return to work.

Psychological symptoms that may arise after an OA include, among others, asthenia and adynamia (associated with inactivity), the perception of personal vulnerability, emotional distress, pain and instability, manifestations of anxiety, depression, or fear about the future, sleep disorders, somatic complaints, behavioural disturbances associated with interpersonal conflicts (namely intimate partner violence), substance use dependencies, and subclinical or clinical post-traumatic stress disorders [23–25].

Although these psychological symptoms may not appear or may be mild and temporary for some injured workers and may disappear over time without the need for specialized help, they can be more severe and persist for others, requiring treatment to prevent or reduce permanent mental health disorders. If these disorders become permanent, they will affect workers' well-being and work capacity, compromising professional reintegration outcomes and increasing the odds of a permanent professional disability (PD — in Portugal, according to No. 1 of General Instructions of Annex 1 of the Decree-Law 352/2007, October 23, it refers to the percentage of functional affectation, which impacts work and earning capacity, as a result of OA sequelae [26, 27]).

In Portugal, PD is assessed at the end of OA recovery and rehabilitation process, when a final personal injury assessment (PIA) is conducted at the insurance company that assumes the responsibility for the accident, and consequently for the treatment, rehabilitation and professional reintegration of the injured worker (Law No. 98/2009, September 4). Typically, the initial recovery period, after the OA, is associated with a total inability to work (temporary total professional disability, TTPD) [26]. When physicians consider that it is possible to begin professional rehabilitation, victims are sent back to work but, in general, they maintain medical insurance support, namely, for rehabilitation; in these cases, a rate of temporary partial professional disability (TPPD) is assigned by the clinician and is periodically reassessed (by adapting it to the respective worker's clinical situation and the type of professional activity) [26, 28]. When clinicians believe that the professional rehabilitation process has been completed, they send the victim to undergo a PIA, which is performed by a medical expert from the responsible insurance company. This expert prepares a PIA report according to official Portuguese rules [26, 29], where, among other things, the current professional status and the presence, or absence, of a PD and, if applicable, its rate and typology, are defined. When present PD can be of three types: permanent partial disability (PPD), there is capacity to resume the essential part of previous tasks, albeit with increased effort and/or some technical adaptations [27]; permanent absolute disability for regular work (PAD-RW), there is a total inability to perform previous work and professional reconversion (workers' requalification and reintegration into a different professional area) is needed [26, 30]; permanent absolute disability for any work (PAD-AW), there is a total disability for any type of work, with professional rehabilitation and reconversion determined to be unfeasible. In our country the

legal process of personal damage assessment and reparation continues after this through the Public Prosecutor Office, as described in Figure 1, until a final decision is made at labour court.

With or without a PD, professional reintegration is one of the most important aspects after an OA and can be mediated by several factors. Common factors that have been associated with poor professional reintegration outcomes are being older; being female; experiencing previous sick leave and unemployment; having high levels of pain and disability; having depression; having anxiety; having high physical work demands; and experiencing perceived limitations in performing daily life and professional activities [12, 13, 31–34]. However, higher education and socioeconomic status, higher self-efficacy and optimistic expectations about recovery and return to work, low injury severity, coordination of the professional reintegration process, and multidisciplinary interventions that include the workplace and stakeholders were found to be factors associated with good outcomes in terms of professional reintegration [12, 13, 31–34]. Employers and workplace conditions also have an important role in professional reintegration. The early engagement of employers in professional rehabilitation and reintegration, along with perceived workplace peer support, accommodations, and flexibility in adjusting job responsibilities and schedules to accommodate individuals' functionality resulting from OA, produces a sense of psychological safety and security in injured workers that has been established as a good predictor of successful professional reintegration [9, 35–39].

Regarding the relation between psychological symptoms, professional reintegration and PD, scientific evidence has been revealing worrying facts: (1) OA injuries that require more than a week off work are more likely to produce long-term impairments to workers' physical and mental health and well-being [25]; (2) OA victims have an overall worse mental health status than the general population, with higher levels of depression, anxiety, and pain scores 1 month after the event, and these outcomes negatively impact both the odds of recovery and the return to work [23, 40–46]; (3) depression prevalence on OA victims' can range between 6%–42%, and anxiety between 4%–24% [47]; (4) injured workers with depression are less likely to be at work 6 months after the OA than non-depressive injured workers (52% *vs.* 73%) [24, 48, 49]; (5) the presence of severe psychological symptoms within 1 year after the OA is a significant risk factor for non-return to work, even 6 years after the injury [12]; (6) higher depression scores 1 month after the OA reduces the odds of return to work in a range between 2 and 12 months [50]; and (7) higher self-reported functional disability and the presence of depression are associated with lower odds of successful professional reintegration after workplace injury [51].

Given the influence of psychological symptoms on return to work and on work capacity, psychological assessment after an OA is extremely important because victims often experience psychological distress that is detectable and treatable.

This study primarily aimed to analyse the relationship between psychological symptoms at the end of the OA recovery and rehabilitation process, and two outcomes: professional reintegration and PD. The specific objectives are to (1) characterize participants and trauma; (2) characterize professional situation and PD assignment (PIA results); (3) describe the participants' psychological statuses, with a focus on reported

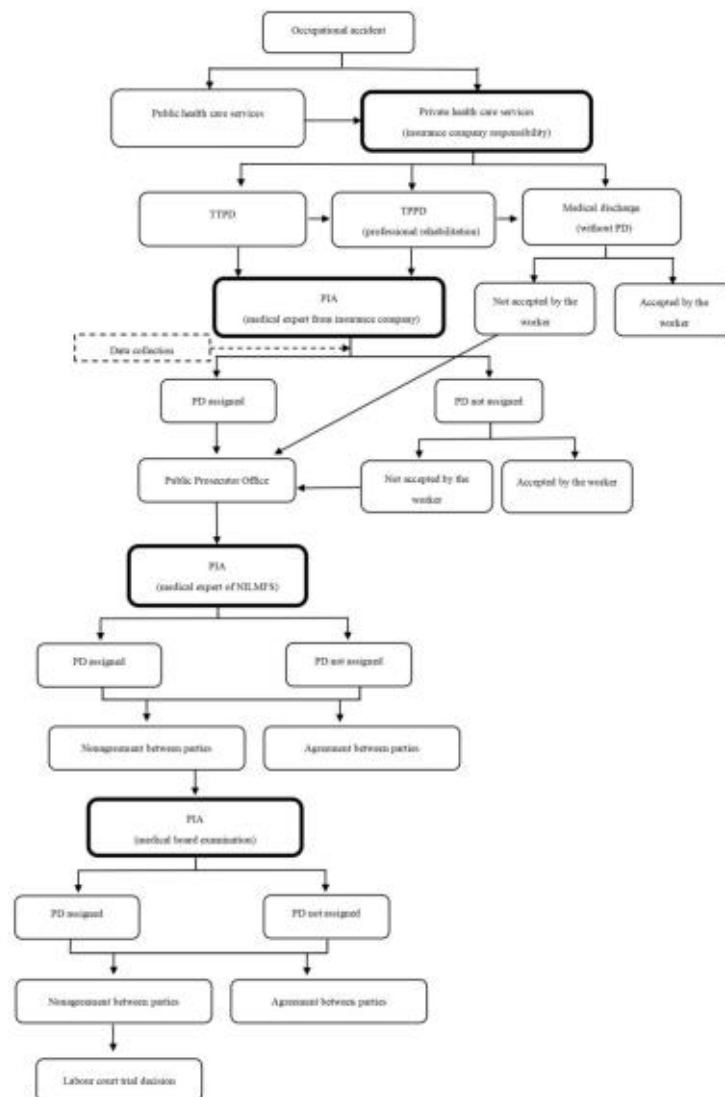


Figure 1 Portuguese system after an occupational accident (treatment and PIAs to support eventual personal damage reparation). TTPD: temporary total professional disability; TPPD: temporary partial professional disability; PD: professional disability; PIA: personal injury assessment; NILMFS: National Institute of Legal Medicine and Forensic Sciences.

symptoms of emotional pain, anxiety, depression, and work and social adjustment (WSA) difficulties; and (4) analyse the relationships between these reported psychological symptoms and professional reintegration outcomes as well as the PD assignment.

Participants and methods

Participants

We recruited injured workers at the end of the OA recovery and rehabilitation process as our participants. Given the fact

that in Portugal all injured workers are assisted by insurance companies before professional reintegration, for this study, this was the only context where our participants could be recruited. Therefore, this source of subjects should not be considered a bias in the study and its results.

The criteria for participant selection included the following: (1) OA victims, regardless of sex, age, or profession; (2) being at the end of the OA recovery and rehabilitation process (already having undergone a final PIA by a medical expert from an insurance company, with the respective report available for consultation); and (3) those with the capacity to consent to participate and respond to clinical interviews and self-administered questionnaires, as assessed by a clinical psychologist. The exclusion criteria were (1) health comorbidities and pre- and post-OA pathologies that could confound responses and (2) the existence of diagnoses of anxious and/or depressive disorders before the OA. The average time span between the OA and the day of the final PIA and study data collection was 201.5 days (standard deviation (SD) = 121.2; Min = 51; Max = 789). A final sample size of 101 participants was obtained.

Methods

A cross-sectional study was conducted using a convenience sample over a 6-month period. Written informed personal consent from the participants and approval of the study protocol by the Ethics Committee of the Faculty of Medicine of Porto University were previously obtained (No. 232/19, 2019 July 19).

Those who met the inclusion criteria were invited to participate and were assured that the study was unrelated to the insurance company's process. After providing written informed consent, the participants underwent a semi-structured interview conducted by an experienced clinical psychologist proficient in clinical evaluation and professional reintegration that assessed their capacity to participate.

Sociodemographic aspects, including age, sex, educational level, marital status, and profession, were evaluated.

The injury severity level was estimated through PD rates assigned by the insurance company PIA according to the following scale [52]: (1) 0: non-existent; (2) 1–5: minor; (3) 6–15: moderate; (4) 16–40: serious; (5) 41–70: severe; and (6) >71: critical.

Emotional pain was assessed using a subjective self-reported measure, in which participants were asked to rate, on a 6-point Likert scale from 0 (none) to 5 (maximum), their current perceived level of emotional pain and suffering related to the experience of OA and its sequelae. Although this scale is not a standardized psychometric instrument, we decided to use it based on the need for a simple, short, intuitive, and direct assessment of participants' present personal experience of suffering.

The participants subsequently completed the following self-administered standardized instruments in a varied order of administration to mitigate fatigue and order effects:

Work and Social Adjustment Scale (WSAS)

This is a self-report scale used to assess the impact of a person's perceived mental health on his or her ability to function in five life domains (home management, work, social leisure, private leisure, and personal or family relationships) [53]. It uses a 9-point Likert scale ranging from 0 (not at all) to 8 (very

severely). The instrument revealed good internal consistency under various conditions of use ($\alpha = 0.79$ – 0.94), as well as a good test–retest correlation ($r = 0.73$), in its original validity study [54]. The Portuguese form has adequate internal consistency ($\alpha = 0.87$) [55]. The scale maximum score is 40, with higher scores representing more difficulties. The results are scored according to three levels of severity: (1) <10: subclinical population; (2) 10–19: significant WSA difficulties but less severe clinical symptomatology; and (3) ≥ 20 : moderate to severe WSA difficulties or worse psychopathology. In this study, this scale was used to assess how participants perceived that their mental health influenced their WSA after the OA.

Generalized Anxiety Disorder Questionnaire (GAD-7)

The GAD-7 is a short scale used as a screening tool and as a severity measure for generalized anxiety disorder [56]. It has a unidimensional structure that corresponds to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) diagnostic criteria for generalized anxiety, including: (1) feeling nervous, anxious or on edge; (2) not being able to stop or control worrying; (3) worrying too much about different things; (4) trouble relaxing; (5) being so restless that it is hard to sit still; (6) becoming easily annoyed or irritable; and (7) feeling afraid, as if that something awful might happen. The participants are asked to evaluate their level of symptoms in the past 2 weeks using a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day). The maximum score is 21, with higher scores representing more severe symptoms. The severity criteria were as follows: (1) ≤ 4 : normal; (2) 5–9: mild; (3) 10–14: moderate; and (4) ≥ 15 : severe. A cut-off point of 10 was established as the score indicating the presence of significant anxiety symptomatology. The Portuguese version, which was used in this study, has good psychometric properties ($\alpha = 0.88$) [57].

Patient Health Questionnaire (PHQ-9)

This 9-item scale is a simple and short screening instrument for depressive symptomatology. The items are based on DSM-IV criteria: sleep, fatigue, appetite and concentration problems, agitation/retardation, anhedonia, depressed mood, self-devaluation, and suicide ideation [58]. It uses a 4-point Likert-type scale ranging from 0 (not at all) to 3 (nearly every day). In its original study, it has shown good internal consistency ($\alpha = 0.86$ – 0.89) and test–retest validity ($r = 0.84$) [58]. The maximum score is 27, with higher scores representing more severe symptomatology. The degrees of severity were defined as follows: (1) 0–4: minimal; (2) 5–9: mild; (3) 10–14: moderate; (4) 15–19: moderately severe; and (5) ≥ 20 : severe. The Portuguese version, which was made available by Pfizer (www.phqscreeners.com), showed good internal consistency ($\alpha = 0.86$), and a score of 9 was determined as the cut-off point for the presence of depression [55, 59, 60].

All self-administered instruments used in this study revealed good internal consistency with our sample ($\alpha \geq 0.70$).

Statistical analyses

All the statistical analyses were conducted using SPSS for Windows version 25.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were employed to characterize the participants' demographic characteristics, accident mechanisms, injury location and severity, current professional status, PD typology and rates, and psychological symptoms

(emotional pain, WSA, anxiety, and depression levels).

To explore differences in psychological symptomatology between professional reintegration outcomes, participants were categorized into two groups: active (victims who had already resumed professional activity, either in the same or different fields) and inactive (victims not currently engaged in professional activity for reasons such as unemployment, sick leave, or retirement). An independent sample *t*-test was conducted to evaluate potential differences in psychological symptomatology between active and inactive participants.

In the analysis of psychological symptoms among PD outcomes, the participants were categorized into two groups: those with PD (comprising victims assigned with PPD, PAD-RW, and PAD-AW) and those without PD. Independent sample *t*-tests were conducted to evaluate potential differences in psychological symptomatology between participants with and without PD.

Correlations between psychological symptoms (emotional pain, WSA, anxiety, and depression levels), sociodemographic variables (age, sex, education, and marital status), injury severity variables, and both PD and professional status groups were assessed using Spearman and Chi-square analyses.

Binary logistic regression was employed to analyse the relationships between emotional pain, anxiety, depression, and WSA symptoms and the likelihood of professional inactivity, as well as the probability of PD assignment, while controlling for age, sex, education, and injury severity. Odds ratios (ORs) were estimated with a 95% confidence interval (95%CI). For all the analyses, statistical significance was set at a *P*-value of less than 0.05.

Results

Participant and trauma characterization

At the time of the accident, the participants' mean age was 44.7 years (SD = 11.2; Min = 18; Max = 69). The majority were male ($n = 84$; 83.2%) and most were married ($n = 69$; 68.3%). The average schooling duration was 8.7 years (SD = 3.4; Min = 3; Max = 17), with most of the participants ($n = 68$; 67.3%) having a low level of education (≤ 9 years). General services and trade personnel ($n = 29$; 28.7%), building workers ($n = 25$; 24.8%) and operators of plants and machinery ($n = 20$; 19.8%) were the most common occupations at the time of the OA. The OA mechanism and injury location and severity are described in Table 1.

Professional status and PD characterization (PIA results)

The professional situation at the end of the OA recovery and rehabilitation process at the insurance company is presented in Figure 2, which shows that the great majority of participants were professionally active.

Figure 3 reveals that more than half of the participants ($n = 55$) were assigned a PD (PPD+PAD-RW), but none was considered totally incapable for work (PAD-AW).

Participants' psychological statuses at the end of the professional rehabilitation phase

Emotional pain was reported by 87.1% of the participants, and its rate was equal to or greater than moderate for 71.3%

Table 1. Occupational accident mechanism, injury location and severity ($N = 101$).

Category	<i>n</i> (%) ^a
Accident mechanism	
Effort trauma	24 (23.8)
Fall from own height	21 (20.8)
Hit by a sharp object	14 (13.9)
Crush	12 (11.8)
Fall from height	11 (10.9)
Road traffic accident (<i>in itinere</i>)	11 (10.9)
Hit by a blunt object	6 (5.9)
Burn	1 (1.0)
Dog bite	1 (1.0)
Injury location ^b	
Upper limbs	51 (50.5)
Lower limbs	45 (45.5)
Raquis/spinal cord	14 (13.9)
Face and/or neck	4 (4.3)
Cranium/brain	3 (3.0)
Chest and/or abdomen	3 (3.0)
Injury severity	
Non-existing	46 (45.5)
Minor	26 (25.7)
Moderate	21 (20.8)
Serious	6 (5.9)
Severe	2 (2.0)
Critical	—

^aPercentages may not add up to 100 due to rounding. ^bInjury location categories are not mutually exclusive.

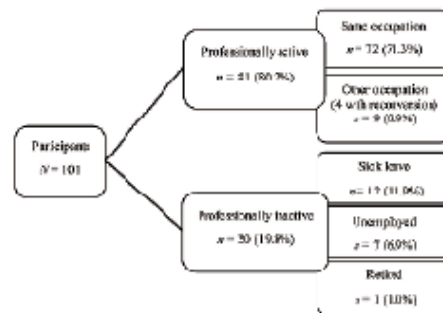


Figure 2 Professional status at the time of final personal injury assessment at the insurance company ($N = 101$).

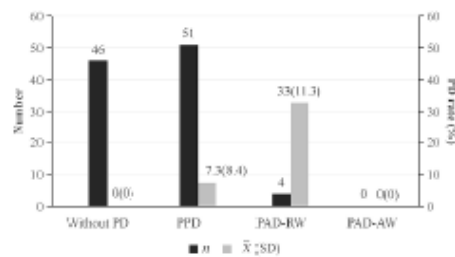


Figure 3 PD assigned at personal injury assessment at the insurance company (*n* and PD rate - $\bar{X}$ (SD) by typology) ($N = 101$). PD: professional disability; PPD: permanent partial disability; PAD-RW: permanent absolute disability for regular work; PAD-AW: permanent absolute disability for any work.

($\bar{X}$ = 2.8; SD = 1.4). WSA difficulties were rated as moderate or severe by 61.4% ($\bar{X}$ = 14.1; SD = 11.1). Anxiety symptoms were reported by 68.3% of the participants, with an average score of 8.7 (SD = 5.6); 40.6% rated these symptoms as moderate or severe. Depression symptoms were reported to be above the cut-off point (≥ 9) by 35.6%, with an average score of 8.2 (SD = 6.4). The results are detailed in Table 2.

Comparisons

Compared with the inactive group, the professionally active group had statistically significant lower levels of depression and WSA difficulties (Table 3).

With respect to PD, WSA difficulties were statistically significantly worse in those assigned a PD (Table 3). Despite not being statistically significant, participants to whom PD was assigned had an average score for depression above the cut-off point ($\bar{X}$ = 9.1; SD = 6.6), which did not occur in the group without a PD ($\bar{X}$ = 7.1; SD = 6.1).

Correlations

For sociodemographic aspects, significant correlations were found only between WSA and marital status. No correlations were found between injury severity and psychological measures. All the psychological measures are correlated with one another. All these results are shown in Table 4.

Logistic regression

The results show that WSA is a significant predictor of the likelihood of being professionally inactive (OR = 1.069; 95%CI = 1.03–1.13; $P < 0.05$), with higher levels of WSA difficulty reducing the odds of being active. Similar results

were found for the probability of being assigned a PD, with WSA difficulties being a good predictor (OR = 0.945; 95%CI = 0.909–0.984; $P < 0.05$).

Demographic variables and other psychological measures (i.e., depression, anxiety, and emotional pain) had no significant influence on either professional activity or PD assignment.

Table 2. Psychological symptoms (N = 101).

Symptoms	n (%) ^a
Emotional pain	
Inexistent	13 (12.9)
Minimal	7 (6.9)
Slight	9 (8.9)
Moderate	44 (43.6)
Intense	20 (19.8)
Maximum	8 (7.9)
Work and social adjustment (WSAS)	
Subclinical	39 (38.6)
Moderated	35 (34.7)
Severe	27 (26.7)
Anxiety (GAD-7)	
Inexistent	32 (31.7)
Mild	28 (27.7)
Moderate	18 (17.8)
Severe	23 (22.8)
Depression (PHQ-9)	
Minimal	37 (36.6)
Mild	28 (27.7)
Moderate	16 (15.8)
Moderately severe	16 (15.8)
Severe	4 (4.0)

^aPercentages may not add up to 100 due to rounding.

WSAS: Work and Social Adjustment Scale; GAD-7: Generalized Anxiety Disorder Questionnaire; PHQ-9: Patient Health Questionnaire.

Table 3. Comparisons of psychological symptoms between groups (N = 101).

Psychological symptom	Professional status				PD							
	Active		Inactive		t (99)	p	Assigned		Non assigned		t (99)	p
	$\bar{X}$	SD	$\bar{X}$	SD			$\bar{X}$	SD	$\bar{X}$	SD		
Emotional pain	2.7	1.4	2.9	1.7	0.6	0.58	2.9	1.4	2.5	1.4	1.3	0.19
Anxiety	8.3	5.7	10.3	5.3	-1.5	0.14	9.3	5.9	7.9	5.2	1.2	0.22
Depression	7.6	6.1	10.9	7.1	-2.1	<0.05*	9.1	6.6	7.1	6.1	1.6	0.12
WSA	12.4	10.2	21.1	11.7	-3.3	<0.05*	16.9	10.7	10.7	10.6	2.9	<0.05*

*Significant at $P < 0.05$; PD: professional disability; WSA: work and social adjustment.

Table 4. Correlations between psychological measures and age, sex, education, marital status, injury severity, professional status and PD (N = 101).

Category	Depression		Emotional pain		Anxiety		WSA	
	ρ	P	ρ/χ^2 (df)	P	ρ	P	ρ	P
Age	0.12	0.25	0.04	0.71	0.78	0.44	0.60	0.55
Sex	0.15	0.15	0.12	0.23	0.19	0.56	0.12	0.23
Education	-0.47	0.64	0.04	0.72	0.12	0.24	0.05	0.62
Marital status	-0.47	0.64	-0.11	0.27	-0.10	0.32	-0.25	0.01*
Injury severity	0.02	0.86	-0.10	0.92	-0.24	0.81	0.17	0.09
Professional status	0.21	<0.05*	4.99 (5)	0.42	0.14	0.15	0.29	<0.05*
PD	-0.17	0.09	2.55 (5)	0.77	-0.10	0.30	-0.32	0.001**
WSA	0.67	<0.001**	0.47	<0.001**	0.63	<0.001**	-	-
Anxiety	0.75	<0.001**	0.37	<0.001**	-	-	-	-
Emotional pain	0.36	<0.001**	-	-	-	-	-	-

*Significant at $P < 0.05$; ** Significant at $P < 0.001$; PD: professional disability; WSA: work and social adjustment.

Discussion

Our study revealed that most participants reported relevant levels of psychological symptoms at the end of the OA recovery and rehabilitation process. These symptoms were more severe in individuals who remained professionally inactive (20%), in accordance with other studies [24, 31, 39, 61, 62].

Participants and trauma

The victims were primarily young men ($\bar{X}$ = 44.7 years). This finding is consistent with official Portuguese statistics [63] and the international literature [64–69].

The professions most frequently involved were those in more physically demanding areas of activity, where the risk of sustaining traumatic injury is higher. Our results of injuries cause and location (effort trauma, falling from one's own height and being hit by a sharp object in 59% of cases, and orthopaedic injuries affecting the limbs in 96% of cases) are also consistent with Portuguese data [63] and the literature [67, 68, 70–73] on global OA, which are substantially different from severe cases [30, 74, 75].

Being male significantly increases the risk of suffering an OA, imposing a reflexion about this fact [76]. This trend might partly be due to the nature and type of professional occupations traditionally performed by men, which frequently are in more high-risk and physically demanding areas, exposing them to more hazards at work [66]. Furthermore, even for the same occupation it has been found that the tasks, and subsequently the type of risks to which workers are exposed, differ for men and women, with more dangers being present for men [76–78]. Additionally, male-dominant work environments often normalize and foster risk-taking cultures [79]. Research on this matter shows that men generally have lower risk perception than women, and therefore are more risk-seeking and tend to underestimate workplace hazards [80, 81], which might also contribute to the fact that men sustain more OA than women.

The fact that OAs occur mainly in young male workers highlights the importance of investing in professional rehabilitation and reintegration services to increase the chances of a successful return to work.

The workers' average schooling level was low and was below the current mandatory level of education in Portugal, which is 12 years. Lower educational levels have been associated with an increased risk of work absence [82, 83] and unsuccessful professional reintegration after OA [13, 30, 84, 85], but our results show other reality. In our study, despite the workers' low average schooling, most of them (80%) were already professionally active, perhaps because we are analysing a global sample of OAs in which most injuries and sequelae were minor, which is demonstrated, respectively, by the low injury severity level (45.5% non-existent, and 25.7% minor) and by the low mean PD rate ($\bar{X}$ = 5.04%; SD = 9.18%), which was assigned to only 55% of the cases (Figure 3).

Our results are consistent with previous findings that younger age, being male, having low injury severity are associated with good professional outcomes. But regarding education and higher physical demands, our results are not consistent with previous findings, since we observed good professional outcomes with participants with low education and more physically demanding tasks, as stated before. This result can also be related with Portuguese legislation as will be discussed below.

Professional status and PD (PIA results)

Portuguese legislation establishes that after an OA, employers have the responsibility to reintegrate injured workers in functions that are compatible with the functional limitations they may present because of the accident, considering their remaining capacities, education and age (Article 44 and Article 155(1), Law No. 98/2009, September 4). Thus, professional reintegration can occur in workers' previous area of occupation (regarding their qualifications, experience and technical-professional competence) or in another area, which is more compatible with the workers' current capacity and functionality.

In our sample, all the participants were medically considered capable of returning to work (with or without PD), but only 80% were successfully professionally reintegrated, most of them in the same professional activity (Figure 2).

From the 20% who remained inactive (Figure 2), 12 were on sick leave assigned by their family doctor; seven became unemployed because of their professional contract type or by mutual agreement between employers and employees; and one retired, by personal choice, due to high age and low educational level, such that he or she considered it would restrain the odds of successful professional reconversion. Given our results (Table 3), we consider that depression symptoms and WSA difficulties are two important factors related to this professional outcome, as will be discussed in the next section. Nevertheless, we cannot ignore that complex interactions of factors, accordingly to other studies on this area, may underlie the non-return to work of these 20 injured workers:

Personal factors [10, 12, 46, 61, 62, 86]: (1) imbalance between the effort required by professional rehabilitation and the worker's perceived gain, leading to a lack of involvement and motivation to do so, and to ask family doctors to prescribe sick leave; (2) self-perceived physical and psychological poor health; (3) difficulties in coping with the discomfort provoked from returning to the same professional context; (4) perceived incapacity to face the same work context with a new functional profile; (5) lack of perceived capacity to adapt to some job activities and demands; (6) perception of being a victim of injustice by peers or employers; and (7) high age, among others;

Work context factors [21, 27, 34, 39]: (1) difficulties in finding professional tasks compatible with the worker's new functionality, especially in smaller companies; (2) companies lack of interest in having employees with disabilities; (3) taking advantage of the event to terminate a professional contract that companies did not want to renew; (4) a lack of peer support and sometimes even harassment; and (5) a lack of awareness, from employers and sometimes from occupational doctors, about the importance of early professional rehabilitation to promote injured workers' health and recovery, among other factors.

Reparation system-related factors [36, 37, 87–89] include the following: (1) financial reparation after OA is directly indexed to the PD rate, and therefore, injured workers may believe that a return to work contributes to decreased PD; (2) the expectation of increased gains from the OA may lead workers to exaggerate the severity of their clinical situation and/or be unwilling to collaborate in the professional rehabilitation process; (3) a lack of information regarding the system may lead workers to search for information with peers and some professionals, which has the potential to be

undeveloped and not clear about the importance of engaging in professional rehabilitation as soon as possible; (4) the complexity of the reparation system, which is often perceived by workers, employers, and health care providers as difficult to navigate, can lead to an additional source of stress that can affect the recovery process and professional rehabilitation; and (5) the perceived sense of injustice/unfairness related to service support and treatment can lead to resistance and litigation with the insurance company, among other factors.

Although we conducted interviews, they were not designed to investigate the reasons why these workers did not return to work. Therefore, further analysis should be conducted to better understand which, if any, of the above-mentioned factors explains this result.

Ensuring effective professional reintegration following an OA is of utmost importance, not only for the injured worker's physical and psychological well-being but also for broader socioeconomic sustainability. We are facing a major challenge of workforce shrinking, mainly as a result of aging, but injuries and disabilities after OAs can aggravate the problem if injured workers are unable to return to work [90, 91]. The development and implementation of workplace health promotion strategies, along with OA prevention policies, are extremely important. Equally important are the development of strategies and interventions that can support professional reintegration after an OA, even for those with more difficulties to return to work. These efforts must ensure that both injured workers and workplace environments can effectively adapt to the functional and occupational performance changes resulting from OAs.

Psychological symptoms at the end of recovery and rehabilitation process

Psychological distress can occur after an OA [13–17]. Even if symptoms frequently disappear after the initial period of adaptation, there are cases in which they might persist over time and require specialized treatment aimed at decreasing their severity or preventing them from becoming permanent [92]. Even though, assessing psychological symptoms within the scope of a personal injury repair system, in which eventual financial compensation is at stake, may be a complex task, nevertheless its relevance is undeniable.

Previous studies have put in evidence the effects of depression, anxiety, emotional distress and pain, and perceived limitation to perform daily and professional activities on professional reintegration, and on the odds of having a PD [12, 13, 40, 41].

In our study, participants reported higher levels of psychological symptoms than expected (Table 2). In fact, this finding seems surprising if we consider the results related to injury and sequelae (PD) severity, which are not proportional. Thus, we admit, in considering the scope in which all this process took place (insurance company), that some participants might have been influenced by one or more of the factors noted before, especially personal factors. It is possible that some had expectations of added gains, even though they were informed, before study participation, that the data collected in this study had no relation with the insurance company process, as the PIA had already been completed. Regardless, it is still important to analyse the results related to each of the studied symptoms, while looking for other eventual reasons that could explain this result:

Emotional pain: In this study, we asked participants to evaluate their current and eventual emotional pain and suffering related to dealing with the consequences of the OA. Although the instrument used here may have limitations, since it was not a standardized measure, we found that 71.3% of the participants rated their emotional pain as equal to or greater than moderate. We hypothesize that some participants were still struggling with the acceptance of and adaptation to changes in their personal, social and professional lives and their functionality due to their OA. The literature indicates that adjusting to OA consequences is often a difficult process with the potential to trigger emotional suffering and distress [13, 93, 94], but we did not find studies that quantified its severity levels. Consequently, these results should alert physicians of the need to consider the possibility of their presence during the recovery period and professional rehabilitation.

WSA: WSA reflects workers' self-perceived capacity to perform in several life domains. Lower levels of self-perceived capacity have been established as predictors of poorer recovery and professional reintegration outcomes [23, 40, 41, 46]. Our results also revealed higher levels of WSA difficulty in both the professionally inactive group ($P<0.05$) and the group with assigned PD ($P<0.001$).

Anxiety: The rates found in this study were higher than anticipated (40.6%, above the cut-off point), since the literature refers to rates between 4% and 24% [47]. Although anxiety has been related to a lower probability of returning to work [11, 12, 95–97] and to factors that might increase professional disability (lower perceived self-efficacy, disruptions in treatment, lower productivity, among others), we did not find significant differences between groups in terms of this symptom. This result may be due to a multiplicity of facts that can overlap: some participants were, in fact, experiencing psychological worrying due to the impacts of the OA on several domains of their lives; others may be naturally stressed when submitted to a medical examination or some other kind of assessment; and others may be, in fact, concerned with questions related to financial reparation. Additionally, anxiety is very prevalent in the Portuguese population [98], although our study participants denied having previous diagnoses.

Depression: The incidence rates were above the cut-off point for 35.6% of the participants, which is consistent with the literature on OA, which established a prevalence ranging from 6%–42% [47]. Some authors consider that depression, as a psychological consequence of OA, may be due to a combination of injury financial burden, difficulties in pursuing compensation claims, long-term pain and suffering, and long recovery processes [44]. In our sample, depression was significantly greater in the professionally inactive group ($P<0.05$), which led us to consider that depressive symptoms strongly interfered with work capacity, as noted in the literature [12, 95–97]. Additionally, similar to anxiety, depression is a very prevalent disorder in Portugal [98], although our study participants denied having previous diagnoses of such mental health conditions.

Our sample was mainly of young man, which made us reflect about the fact that male injured workers might face unique barriers to adaptation and recovery after OA, largely due to internalized and societal definitions of masculinity, that can lead to experience OA sequelae as failures or being less capable [76]. This stigma can complicate professional

rehabilitation and reintegration, since there can be a struggle with the emotional burden of feeling “broken” or “less of a man”, which can lead to increased emotional pain, anxiety, depression, or social isolation, that culturally can be more difficult to express and ask for help in men than in women. Paradoxically, while men can be discouraged from showing vulnerability, there is also the possibility that some may exaggerate their symptoms, perceiving secondary benefits such as extended leave or financial compensation. This duality reveals the complexity of masculine identities in relation to psychological well-being and calls for further research.

The most relevant goal is to keep track of the expression of these symptoms, helping professional reintegration and preventing them from becoming permanent. Furthermore, early professional rehabilitation and reintegration are extremely important not only for fostering recovery but also for increasing perceived health status and capacity, which in turn acts as a protector against psychological problems, such as depression [12, 95–97].

These results suggest that all psychological symptoms should be identified early, interpreted and treated (when necessary) to help workers be emotionally more stable during the professional rehabilitation phase.

Interest in psychological symptom screening and follow-up after an OA

Professional reintegration after an OA constitutes a complex process, with several internal and external dimensions acting as positive and/or negative interferences. This process is tremendously important at the familial, social and financial levels for reducing costs related to work absences and medical care related to the secondary impacts of an OA. However, it is even more important at the personal level as a way of reducing workers' financial dependence and improving their physical and cognitive capacity, quality of life, well-being, social participation, and sense of utility. In fact, being professionally active can be considered a protective factor for physical and psychological health [12, 95, 99, 100].

Psychological and psychiatric consequences may be a direct result of the trauma (primarily in traumatic brain injury cases) but also a secondary result from the experience of the OA (an adaptive reaction to a stressful/traumatic experience). The link between these outcomes and the event may be difficult to determine, especially in the last situation, which is the most frequent, because we are often addressing each person's subjectivity and sometimes previous mental health conditions, within the scope of an insurance company/financial reparation system. However, this possibility cannot be a reason to ignore the symptoms. Injured workers' psychological status should be assessed as early as possible and, if present, monitored and treated, preventing them from becoming permanent, avoiding litigation [24, 101], and empowering professional rehabilitation and reintegration processes [9, 35–38]. It is also important that insurance company professionals are alert and use instruments that allow them to identify and distinguish victims who indeed need psychological treatment from those who are, consciously or unconsciously, searching for financial compensation benefits, not only during recovery and rehabilitation but also during the professional reintegration phase. All health professionals involved in professional rehabilitation and reintegration should keep in mind that for those to whom psychological symptoms and disorders arise

after the OA, treatment has to be provided at any stage of the process.

Therefore, it is very important to be alert to psychological symptoms that may arise after the OA, screen them, and, if needed, offer treatment to help injured workers cope with the situation, reducing their probability of experiencing long-lasting disability. It is also important to analyse whether there is a gap in the practice of systematic, measurable and standardized assessment of the effects of psychological symptoms on OA consequences.

Limitations of the study and further studies

The main limitations of this study are as follows: (1) the methodological characteristics of a cross-sectional study design; (2) the use of a convenience sample; (3) the sample dimension; (4) the use of psychological measures at only one timepoint, which prevented us from better understanding participants' psychological status evolution at different stages of the recovery process; (5) the use of a non-standardized measure of emotional pain that does not capture the full complexity of emotional pain, such as its duration and intensity over time, and does not have standardized norms; (6) the fact that we did not collect information related to socioeconomic status, medication, job demands, and social support, which could have helped us to better understand our results.

To comprehend the impact of psychological symptoms during professional rehabilitation and reintegration, further studies with larger samples should be conducted that consider: (1) psychological dimensions at different stages of the recovery process and their effects on PD and professional reintegration; (2) early assessment of psychological status and analysis of its impact on professional outcomes; (3) the use of standardized measures of emotional pain; (4) the use of malingering instruments to mitigate possible bias; and (5) exploring if there are significant differences between men and women regarding psychological symptoms.

Conclusions

Our study results show the following: (1) Most of the participants reported psychological symptoms at the time of the PIA at an insurance company at a level equal to or above moderate: emotional pain (71.3%); difficulties at WSA (61.4%); anxiety (40.6%); and depression (35.6%). (2) The professionally inactive group (20%) presented higher levels of all these symptoms, with significant differences in WSA difficulties and depression ($P < 0.05$). (3) The assigned PD group (55%) presented higher levels of all these symptoms, with significant differences in WSA difficulty ($P < 0.001$). (4) WSA was revealed to be a good predictor of both professional status and PD attribution ($OR = 1.069$; 95%CI = 1.03–1.13; $P < 0.05$).

Even if only WSA acted as a predictor of professional reintegration and PD, the higher levels of all the psychological measures in the inactive and PD groups may act as an alert sign. We believe that screening for psychological symptoms after OA should always be performed during the recovery process, regardless of their structural or reactive nature. Their treatment and monitoring may be very useful for supporting an early professional rehabilitation process and reducing negative professional outcomes, ensuring better reintegration.

This approach will be very important not only for promoting workers' health and quality of life by reducing the odds of long-term psychological symptoms, but also for familial, social and financial reasons.

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Authors' contributions

All the authors contributed to the study conception and design. Material preparation and data collection were performed by Isabel Almeida and Teresa Magalhães. Statistical analyses were conducted by Isabel Almeida and Pedro M. Teixeira. The results were analysed and discussed by all the authors. The first draft of the manuscript was written by Isabel Almeida, and all the authors commented on previous versions of the manuscript. All the authors read and approved the final version of the manuscript.

Compliance with ethical standards

The present study was approved by the Ethics Committee of the Faculty of Medicine of Porto University (No. 232/19, 2019 July 19). This research was conducted in accordance with the Declaration of Helsinki. Guarantees of anonymity given to participants were honoured. Written informed consent was obtained from all the individual participants included in this study.

Disclosure statements

The authors have no relevant financial or non-financial interests to disclose.

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Health-related quality of life after an occupational accident. A professional reintegration and forensic approach.

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Abstract

Health-related quality of life perception (HRQoL) reflects the impact of individuals' health conditions on physical, psychological, and social well-being, and can be compromised after an accident. The general aim of this study was to analyse the effect of occupational accidents (OA) outcomes on injured workers' HRQoL. We conducted a cross-sectional study, using a convenience sample of 101 participants at the end of their recovery and professional reintegration (PR) process. They were submitted to a personal injury assessment (PIA) by medico-legal specialists, and data related to injury severity (IS), permanent professional disability (PD) and PR were collected from the respective forensic report. Subsequently they underwent a psychological interview, and they fulfilled self-report questionnaires to measure HRQoL (SF-36) and resilience (RSA). For each variable two groups were defined. Analyses included descriptive statistics, correlations, and group comparisons. Injured workers reported lower HRQoL than Portuguese norms across most domains. HRQoL scores were positively linked to resilience and PR, and negatively affected by IS and PD. These findings highlight the importance of a biopsychosocial and multidisciplinary approach to OA victims' professional reintegration, integrating physical treatment, psychological support with resilience-building, and work rehabilitation, before medical discharge and PIA.

Keywords

Health related quality of life; Occupational accident; Professional outcomes; Professional rehabilitation; Professional reintegration; Medico-legal evaluation; Personal injury assessment.

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The impact of major occupational injuries on professional reintegration. A Portuguese medico-legal contribution

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