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Financial retirement planning processes in the Netherlands: How do they differ between employees and solo self-employed workers?

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Abstract The solo self-employed workforce is growing across Europe, a group which often faces greater individual responsibility for retirement preparation than employees. Using a situational strength framework, this study investigates psychological mechanisms behind retirement planning among employees and three types of solo self-employed workers: voluntary, natural, and forced. Based on survey data from 3,450 Dutch workers aged 40–67, a multi-group structural equation model reveals that, compared to employees and other types of solo self-employed workers, future time perspective influences perceived retirement savings adequacy considerably more strongly among voluntary self-employed workers. These findings underscore the situational-contingent nature of

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retirement planning and highlight the vulnerability of certain self-employed groups in pension policy debates.

Keywords retirement, self employment, precarious employment, social security financing, psychological aspect, Netherlands

Introduction

In the context of increasingly flexible labour markets, the group of solo self-employed workers (i.e. self-employed and without personnel) has risen in many European regions (Boeri et al., 2020). This trend has sparked concerns about financial preparedness for retirement in different countries, including the Netherlands (Fachinger and Frankus, 2017; Salonen, Koskinen and Nummi, 2020; Zwinkels et al., 2017), because national pension systems have different approaches to the pension coverage of self-employed workers. Whereas most Dutch employees are automatically covered by "quasi-mandatory" employer-sponsored pensions, the solo self-employed carry much more individual responsibility to prepare for retirement (Damman and van Solinge, 2019). They are assumed to be entrepreneurial individuals who have the forward-looking psychological abilities and financial means to adequately prepare for their old age (Schippers, 2019). It is questionable, however, to what extent and among whom this assumption holds. Increasingly, the literature points to the existence of workers in precarious conditions being self-employed (Boeri et al., 2020; Tammelin, 2019; Visser, Damman and Kraaykamp, 2024). Next to the individuals who have deliberately chosen to become solo self-employed, there are workers who involuntarily became solo self-employed (Conen, Schippers and Schulze Buschoff, 2016), and persons who have chosen a profession that appears to be mainly conducted in self-employment. This raises the question: to what extent and how do the psychological mechanisms that underlie financial retirement preparation differ between employees and these types of solo self-employed workers in the Netherlands?

There is not only a rich body of economic literature focusing on financial retirement planning, but the topic has also received attention from psychologists and sociologists (Adams and Rau, 2011; Ren and Lim, 2023). One central psychological model, for which support has been found in many empirical studies, has been developed by Hershey and colleagues (França and Hershey, 2018; Hershey, Henkens and van Dalen, 2007; Hershey et al., 2007;

van Dalen, Henkens and Hershey, 2010). The model posits a "sequence of relationships between personality constructs (such as future time perspective), cognitive constructs (such as goal clarity and financial knowledge), and behaviour (such as retirement planning activities)" as precursors of perceived retirement savings adequacy (Hershey et al., 2007, p. 368). Even though the general structure of the psychological model holds in many studies, the strength of the relationships differs across country contexts. In the United States, where individuals bear great individual responsibility to finance their retirement, the relationships have been found to be stronger (and the model to be more robust) than in the Dutch context where employees carry less individual responsibility to save (Hershey, Henkens and van Dalen, 2010; Hershey et al., 2007). This indicates a puzzling situation for solo self-employed workers in the Netherlands, who have a great deal of individual responsibility to prepare for retirement in a country context where retirement financial planning decisions are highly centralized for the majority of workers. An important question therefore is whether the strength of these relationships between psychological constructs differs between the solo self-employed and employees in the Netherlands.

Even though the differences between solo self-employed workers and employees in the strength of the psychological preparation mechanisms have to our knowledge not been examined before, there are earlier studies focusing on differences in retirement processes between these groups. Research among retirees has shown that former self-employment increases the likelihood of having a lower (pension) income in old age (Höppner, 2021; Pettinicchi and Börsch-Supan, 2019). Studies on retirement timing have demonstrated that self-employed workers on average (prefer to) retire later as compared to employees and speculate that this finding may at least be partly due to the financial unpreparedness of self-employed workers (Visser et al., 2016; Zwier, Damman and Van Den Heuvel, 2020). Retirement preparation research has shown that self-employed workers are less likely to financially prepare for retirement than employees (Rostamkalaei, Nitani and Riding, 2022), although findings in this respect seem to be mixed (Koh and Mitchell, 2019). Studies focusing on diversity *within* the solo self-employed group have demonstrated that involuntary solo self-employed workers are less well-prepared than their voluntary counterparts (Conen, Schippers and Schulze Buschoff, 2016; Hershey et al., 2017). This suggests that it is not only important to compare employees with the solo self-employed, but also to examine heterogeneity within the solo self-employed group (Beusch and van Soest, 2020).

This study will contribute to the literature in three ways. First, it will include the solo self-employed in studies about the psychological mechanisms underlying retirement preparation, instead of solely focusing on employees. As such, this study will bridge two strands of literature, that is, literature about financial

retirement planning and literature about self-employment. Second, diversity within the solo self-employed group will be taken into account. More specifically, we will move beyond the voluntary/involuntary dichotomy, by also distinguishing a third group of solo self-employed workers, who are engaged in a profession that appears to be mainly conducted in self-employment (so-called "natural" self-employed workers, cf. van der Lecq and Oerlemans, 2015). Third, by examining differences in the strength of the psychological preparation mechanisms (i.e. the sequential relationships between personality, cognitive factors, behaviour, and perceived retirement savings adequacy) across labour market groups, this study adds to our understanding of the situational contingency of psychological retirement preparation processes. Starting from the notion that retirement preparation can be seen as a process of agency within structure, we will apply image theory (Beach and Mitchell, 1987) and situational strength theory (Meyer, Dalal and Hermida, 2010) to derive and test new theoretical expectations.

This article is based on data from the "*Views on retirement in the Netherlands*" survey (Damman and Kraaykamp, 2022). These data are highly suitable to examine the research question of this study, given that they comprise detailed information about the psychological retirement planning process (i.e. about future time perspective, goal clarity, planning activities and perceived retirement savings adequacy) and include both a large sample of 1,699 employees and of 1,751 solo self-employed workers. In the Netherlands, both employees and the self-employed are eligible for the public basic old-age pension (*Algemene Ouderdomswet* – AOW), upon reaching the state pension age.[1] This ensures a minimum financial safety net based on the years of residence in the country (Damman and van Solinge, 2019).[2] In addition, employees are generally automatically enrolled in employer-sponsored pension funds. Most self-employed workers, however, bear individual responsibility for additional retirement savings (Hershey et al., 2017). As such, self-employed workers need to save individually to achieve comparable replacement rates to employees. Examining their psychological retirement preparation processes in depth is therefore highly relevant, because it may offer starting points for how to support the solo self-employed in their preparation endeavours. Engaging in financial retirement planning has been shown to be of importance to ensure well-being during retirement (Noone et al., 2022).

In the remainder of this article, we look first in detail at the vast literature on the theory of financial retirement planning. We then set out our data and methods and

1. Age 66 and 10 months; gradually rising to age 67 and 3 months by 2028. See ISSA Country profiles.
2. For the full pension, must have been a resident of the Netherlands or working in the Netherlands from age 17 (in 2024) to the standard retirement age; if income was earned, the insured must have paid contributions each year in this period. See ISSA Country profiles.

present our results. We conclude with a discussion and highlight the policy implications for retirement planning for different types of solo self-employed workers in the Netherlands. In a global context of the flexibilization of labour markets, this discussion considers the implications generally for workers in precarious forms of work.

Theory

Research on financial retirement planning has frequently relied on economic theories, which often assume that "people make rational, consistent, intertemporal plans" (Deaton, 2005, p. 103). However, individual behaviours often deviate from rationality (Benartzi and Thaler, 2007). As a result, there is growing recognition of the need to explore the social, psychological and institutional factors underlying financial preparation for retirement (van Dalen, Henkens and Hershey, 2010). Saving for retirement can be seen as a process of agency within structure (Settersten, 2003). Workers can actively save for retirement, but the importance of this process, and the opportunities and constraints they face, may vary depending on their context. As such, perceived retirement savings adequacy – i.e. the individual perception of whether future savings will be sufficient during retirement – can be expected to be affected by individual predispositions, which interact with contextual features.

First, we provide a theoretical account on how a central personality trait, "future time perspective", influences the perceived adequacy of retirement savings. Second, inspired by image theory (Beach and Mitchell, 1987), we argue how this relationship can be expected to be mediated by retirement goal clarity and financial planning behaviours (Hershey, Henkens and van Dalen, 2007; Stawski, Hershey and Jacobs-Lawson, 2007). Third, informed by situational strength theory (Meyer, Dalal and Hermida, 2010), we argue how this psychological preparation process may vary between employees and (different types of) solo self-employed workers, because of the highly different retirement contexts these groups of workers face.

The impact of future time perspective on retirement savings adequacy

Most important life decisions require to look ahead. Bandura (2001) posits that forethought is one of the key dimensions of human agency, defined as "intentionally making things happen" (Bandura, 2001, p. 2). In the psychological literature, this trait has been operationalized as future time perspective, which refers to "a general concern for and corresponding consideration of one's future" (Kooij et al., 2018, p.10). Kooij et al. (2018) show that future time perspective is

positively linked to multiple positive outcomes, including individual achievement in different domains. Individuals with a high level of future time perspective are more likely to connect their present actions with future outcomes, and to place more value on future rather than short-term goals (Simons et al., 2004).

Financial retirement planning is a complex process, as it requires forethought: for example, balancing current and future consumption, predicting future income stability and employment trajectory, and accounting for one's life expectancy (Ekerdt, 2010). Due to this complexity, prior research has suggested that future time perspective may be a key psychological factor shaping financial retirement preparation (Hershey and Mowen, 2000; Kerry, 2018). Forward-looking individuals can be expected to be more likely to feel secure, confident and planful when making retirement saving decisions. In fact, much empirical research shows that future time perspective is an important personality trait linked to perceived retirement savings adequacy (Hershey, Henkens and van Dalen, 2010; Hershey et al. 2017; Hershey, Henkens and van Dalen, 2007; Hershey and Mowen, 2000; van Dalen, Henkens and Hershey, 2010). Hence, in the current study, we also expect that future time perspective is positively associated with perceived retirement savings adequacy (H1).

The mediating role of retirement goals and financial planning behaviours

According to image theory (Beach and Mitchell, 1987), goals and strategies play a key role in connecting how people think about the future with the outcomes they hope to achieve. People with a strong future time perspective tend to picture themselves in the future and set specific goals. These clear goals often motivate them to create plans to reach those goals. The theory suggests that by setting goals and creating actionable strategies – essentially making and following concrete plans – people feel more confident about achieving their desired future outcomes.

In the retirement setting, image theory would suggest that forward-looking people set retirement goals, which lead to concrete retirement saving strategies. Individuals who are forward-looking project themselves into retirement, imagining how it will be spent. This provides a sense of direction, making it easier for individuals to engage in specific financial behaviours, such as saving, investing and budgeting. In turn, engagement in financial behaviours would lead to feel more secure and confident about making ends meet during retirement. Hershey, Henkens and van Dalen (2007) proposed an integrated model of financial retirement planning, where future time perspective affects perceived savings adequacy mediated by retirement goal clarity and financial retirement planning behaviours. This model has received ample empirical confirmation (for

an overview, see Ren and Lim, 2023). The existing empirical findings suggest that these core psychological elements significantly predict perceived retirement savings adequacy, even when accounting for socio-demographic variables such as age, education and income (Hershey, Henkens and van Dalen, 2010; van Dalen, Henkens and Hershey, 2010). Moreover, the model holds for employees residing in different country contexts, such as the United States, Netherlands, Brazil and India (França and Hershey, 2018; Hershey, Henkens and van Dalen, 2010; Hershey, Henkens and van Dalen, 2007; Tomar et al., 2021). In line with this, we suggest that the positive effect of future time perspective on perceived retirement savings adequacy is sequentially mediated by retirement goal clarity and financial retirement planning behaviours (H2).

The differential impact of future time perspective by employment status

Some situations require individuals to be more deliberate and planful than others. Situational strength theory (SST; see Meyer, Dalal and Hermida, 2010) posits that the influence of personality traits on (expected) outcomes depends on the situation's strength. In strong situations, people tend to behave similarly because clear cues, such as formal rules and external pressures, guide their actions (Cooper and Withey, 2009). These cues reduce the overall impact of individual attributes on future outcomes. In contrast, weak situations allow more room for individual agency. In the absence of social cues and external constraints, personal attributes will exert a greater influence on behaviour and outcomes.

Damman and Henkens (2017) provided some examples with regard to retirement planning on how agentic capacities could be more or less important, depending on the situational context. One example is the national context, since countries have very different pension institutions with different financing mechanisms. Some countries have contributory systems, while others operate tax-financed universal pension systems or provide means-tested assistance. Many countries operate multi-pillar pension systems, wherein different pillars have different financing mechanisms and are designed to address different policy aims (see, for example, Holzmann, 2013). Moreover, there may be centralized (government) institutions responsible for the governance and administration of pensions, or aspects of these roles may be externalized to (semi-)private institutions or sectoral pension funds. Employers may be more or less central in supporting workers in the process of building up entitlements to a pension, for example by offering set pension plans or by matching contributions. In some countries, employees are automatically enrolled in pension plans, while in others they are responsible for their own retirement planning (OECD, 2023, p. 220).

Such institutional features can be expected to shape the leeway of individual agency in planning and saving.

In the Dutch pension system, the combination of state pension (AOW, first pillar) and quasi-mandatory employer-sponsored pension plans (second pillar) ensures solid pension coverage for employees. However, while in many Member countries of the Organisation for Economic Co-operation and Development (OECD) the design of the multi-pillar pension system presents little differences between self-employed workers and employees (Choi, 2009; Höppner, 2024), this is not the case for the Netherlands. While the first pillar is universal, the second pillar is mostly designed for employees. This means that most self-employed workers do not automatically build up any pension entitlements beyond the basic state pension benefit. From a policy perspective, this design approach aligns with a view of solo self-employed workers as self-reliant entrepreneurs (Cieślik and van Stel, 2024). According to this principle, they are expected to insure themselves against future risks such as unemployment, illness, and old-age poverty. As such, these workers must assume a high level of responsibility for their own additional retirement savings (Hershey et al., 2017).

Framed in terms of situational strength theory, employees are in a strong situation compared to self-employed workers. First, this can be seen in the Dutch institutional pension design of the second pillar, which makes it almost automatic for employees to save, while most self-employed workers are free to decide how and how much to save. Second, employees are generally embedded in an organizational environment, which can provide social cues on how people in a similar situation (i.e. colleagues) behave (Duflo and Saez, 2002), while self-employed workers are typically more isolated in their decision making. Given that stronger situations "attenuate subsequent trait–outcome relationships" (Meyer, Dalal and Hermida, 2010, p. 122), individual personality traits such as being forward-looking (directly, as well as indirectly mediated by retirement goals and financial planning activities) may play a less important role in shaping expectations about future retirement income for employees than for self-employed workers.

However, solo self-employed workers are not a homogenous group (Beusch and van Soest, 2020). The economic literature often suggests that solo self-employed workers are a select group of individuals with entrepreneurial capabilities (Schippers, 2019). In this view, entering self-employment is assumed to be a conscious choice made to seize a business opportunity (Fairlie and Fossen, 2020). However, this assumption has recently been questioned (Boeri et al., 2020; Conen, Schippers and Schulze Buschoff, 2016; Conen and Reuter, 2024), as there are other ways people enter self-employment. The first case includes "natural" solo self-employed workers: they may be self-employed because their profession is usually arranged that way, and not necessarily due to an inner desire to be an

entrepreneur (van der Lecq and Oerlemans, 2015). This is a well-known scenario in certain industries, such as in the creative (i.e. photographers) and artisan (i.e. piano tuners) industries, or in professions such as translators or interpreters. The second case includes "forced" self-employed workers (Fairlie and Fossen, 2020). These workers are unable to find a salaried occupation (cf. "necessity entrepreneurship"; Fairlie and Fossen, 2020), or are pressured by their employer to work as subcontractors in what is also called "dependent" or "bogus" self-employment (Williams and Horodnic, 2019). This may be the example of delivery couriers or construction workers.

Solo self-employed workers who have consciously chosen their work regime may have been able to foresee the financial and administrative challenges of their position. Moreover, they may see themselves being self-employed for a longer period, as it was their own choice. For these workers, thinking about the future and thinking about retirement may represent two related issues (van Dalen, Henkens and Hershey, 2010). In contrast, "natural" and "forced" self-employed workers may be in a more constrained position. "Natural" self-employed workers may have not deliberately chosen to be entrepreneurs, but this may be so mainly due to their profession. Some professions are increasingly undertaken in self-employment due to ongoing flexibilization trends. For instance, in the creative industries, permanent contracts have declined while solo self-employment has risen (Been and Keune, 2024). As such, these "natural" self-employed workers may face challenges dealing with the financial and administrative responsibilities that accompany the self-employed status. "Forced" self-employed workers are the group with the most constrained agency, as they were coerced into self-employment. They may see their work regime as a transitionary state and may hope to find a salaried occupation. In such situations of constrained agency, situational strength theory (Meyer, Dalal and Hermida, 2010) posits that psychological traits may be less important, since the outcome (that is, perceived future savings) is ultimately determined by the situation rather than the individual agent. For voluntary self-employed workers, the absence of external constraints gives more leeway for the expression of their psychological traits, such as future time perspective. For "forced" and, to a lesser degree, "natural" self-employed workers, psychological traits may be suppressed by the constraints they face, such as financial hardship, or struggles undertaking their own administration. All in all, we expect that future time perspective (directly, as well as indirectly mediated by retirement goal clarity and financial planning activities), has a stronger effect on perceived retirement savings adequacy for voluntary compared to natural/forced self-employed workers, and as compared to employees (H3).

Data and methods

Data

To test the hypotheses, data from the "Views on retirement in the Netherlands" study are analysed (Damman and Kraaykamp, 2022). These are survey data based on a web-questionnaire, which were collected between 25 January 2021 and 8 February 2021. The study population comprises of solo self-employed workers and employees aged 40+ in the Netherlands. The data collection has been conducted by two organizations: I&O Research and Kantar. To reach a sufficiently large group of solo self-employed individuals, these organizations collected the data via two large-scale online panels (I&O Research Panel and the NIPObase Panel).[3] Completion of the questionnaire took on average 15 minutes. The overall response rate was 55.9 per cent. An important advantage of both these panels is that respondents were sampled by the organizations (no self-registration into the panel). I&O Research and Kantar store the collected data decoupled from personal information, as prescribed in the European Union's General Data Protection Regulation.

The participants were asked questions about various aspects of their retirement preparation processes, work characteristics and socio-demographic background. Respondents self-classified themselves into their work regime at the beginning of the questionnaire. Only those who classified themselves as either employees or solo self-employed workers were invited to continue the survey. Those who reported to have a side job were classified according to their main work regime. After excluding the participants that were older than the statutory retirement age (66 years and 4 months at the time of the survey), the final group size is 3,450 workers, of which 1,699 are employees and 1,751 are solo self-employed workers.

Variables and measures

Future time perspective, retirement goal clarity, financial retirement planning behaviours, and perceived retirement savings adequacy were all measured with items used in previous studies (Hershey, Henkens and van Dalen, 2010; Hershey, Henkens and van Dalen, 2007)[4] and treated as latent variables. Socio-demographic variables were used as controls and included age, gender, education, and income. More information on the variables and coding is presented in Table 1.

3. Data not publicly available.
4. Two items, RGC1 and FRPA3, were slightly adapted to better suit the Dutch language and context.

Table 1. *Descriptive statistics, coding, and description of variables used in the models*

	Employees		Voluntary SSE		Natural SSE		Forced SSE			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Coding	Description
Variable										
Age	56.62	7.40	55.27	7.13	55.27	6.81	57.71	6.49	Continuous	
Gender									Dummy (0 = Man, 1 = Woman)	
Man	0.54		0.51		0.38		0.55			
Woman	0.46		0.49		0.61		0.45			
Education	2.45	1.00	2.95	0.88	2.98	0.85	2.91	0.87	Continuous (1 = Low, 4 = Very high)	Obtained from survey agencies. Originally coded into 6 categories. Recoded into 4 educational categories to make sure all groups include sufficient observations.
Income	4.25	1.58	3.98	2.15	2.81	1.83	2.96	1.95	Continuous (1 = Less than 1.000, 7 = More than 4.000)	"What is your approximate net monthly income, altogether, for the work you do? If you have fluctuating income, can you estimate the average net monthly income for the past six months?". Originally coded in 8 categories in steps of 500 euros. Recoded into 7 to make sure all groups include sufficient observations.
FTP1	3.40	0.89	3.42	0.88	3.29	0.98	3.25	0.97	Continuous, coding 1 = Completely disagree, 5 = Completely agree	Can you indicate to what extent do you agree with the following statements: "I enjoy thinking about how I will live years from now in the future"
FTP2	3.66	0.79	3.69	0.76	3.54	0.86	3.56	0.86	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"It is important to take a long-term perspective on life"
FPT3	3.07	0.82	3.13	0.86	2.99	0.92	3.08	0.83		"My close friends would describe me as future oriented"

(Continued)

Table 1. *Descriptive statistics, coding, and description of variables used in the models* - Continued

	Employees		Voluntary SSE		Natural SSE		Forced SSE			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Coding	Description
									Continuous, coding 1 = Completely disagree, 5 = Completely agree	
RGC1	2.68	1.11	2.42	1.02	2.16	1.01	2.54	0.11	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"I have thought a great deal about life in retirement"
RGC2	2.39	1.05	2.59	1.13	2.17	1.06	2.41	1.15	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"I set specific goals for how much will need to be saved for retirement"
RGC3	2.78	1.08	2.70	1.07	2.44	1.09	2.70	1.14	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"I have a clear vision of how life will be in retirement"
FRPA1	2.48	1.26	2.60	1.35	2.16	1.18	2.45	1.31	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"Calculations have been made to estimate how much money I need to save to retire comfortably"
FRPA2	3.17	1.31	3.02	1.37	2.61	1.35	2.99	1.39	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"I have informed myself about the level of my future pension benefits"
FRPA3	2.94	1.33	2.95	1.37	2.43	1.27	2.71	1.35	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"I have informed myself about financial planning and pensions during the past few years"

(Continued)

Table 1. *Descriptive statistics, coding, and description of variables used in the models* - Continued

	Employees		Voluntary SSE		Natural SSE		Forced SSE			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Coding	Description
PRSA1	3.66	1.08	3.47	1.19	3.20	1.20	3.11	1.32	Continuous, coding 1 = For sure not, 5 = Completely sure	"Suppose you would stop working completely when you reach the state pension age (AOW). Do you think you will have acquired enough pensions and other sources of income to retire comfortably?"
PRSA2	3.32	1.00	3.12	1.15	2.77	1.12	2.68	1.23	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"I am saving enough to retire comfortably"
PRSA3	3.42	0.97	3.07	1.12	2.78	1.14	2.75	1.24	Continuous, coding 1 = Completely disagree, 5 = Completely agree	"I expect to have a good retirement income"
N	1.699		1.048		341		362			

Notes: SSE stands for Solo Self-employed. FTP = Future Time Perspective, RGC = Retirement Goal Clarity, FRPA = Financial Retirement Planning Activities, PRSA = Perceived Retirement Savings Adequacy.
Source: Authors' elaboration.

Employment status was constructed by combining two different variables. The first variable represents the main work regime of the respondents, measured by the question "Which situation most applies to you right now?". Respondents could choose between a variety of work regimes, but only employees and solo self-employed workers were asked to continue the survey. Solo self-employed participants were further asked: "People can work as solo self-employed worker/freelancer for a variety of reasons. Which description fits the best with your situation?". The possible answers were 1 = "It was natural for me to become solo self-employed. My profession is almost never done in salaried employment"; 2 = "I have consciously chosen to be solo self-employed. My profession can be performed both in salaried and self-employment"; and 3 = "I was forced into solo self-employment". Self-employed workers in category 2 were classified as voluntary self-employed workers, those in category 1 as natural self-employed workers, and those in category 3 as forced self-employed workers.

Analysis

To answer the research questions and test the hypotheses, Structural Equation Modelling (SEM) was used. We estimated three models: Model 1 including future time perspective (FTP) as the predictor of perceived retirement savings adequacy (PRSA); Model 2 including retirement goal clarity (RGC) and financial retirement planning activities (FRPA) as mediators (including controls for age, income, gender, and education); and Model 3 consists of Model 2 where parameters were allowed to vary between employees and voluntary, natural, and forced self-employed workers. Before estimating Model 3, we estimated a measurement model and we tested for measurement invariance between employees and voluntary, natural, and forced self-employed workers (Horn and McArdle, 1992; van de Schoot, Lugtit and Hox, 2012). We established partial metric invariance between the groups. More details on this analysis can be found in the online Appendix.[5] Data handling was done using Stata 17 and analyses were performed using R with the package Lavaan (Rosseel, 2012).

Table 2 shows pairwise Pearson correlation coefficients of all variables in the model, including controls (all significant at a 0.05 level). Since indicators of the main latent variables were based on five answer categories, they were treated as continuous (Rhemtulla, Brosseau-Liard and Savalei, 2012); hence, maximum likelihood estimators were used. Missing data were low, with the exception of income, which was missing for 4 per cent of employees, 10 per cent of voluntary and forced self-employed workers, and 12 per cent of natural self-employed

5. This article is supplemented by an online Appendix developed by the authors and made available to readers (see Supporting information). See Appendix A.1.

Table 2. *Pairwise correlations of variables included in the models*

Variable	Age	Gender	Education	Income	ftp1	ftp2	ftp3	rgc1	rgc2	rgc3	frpa1	frpa2	frpa3	prsa1	prsa2	prsa3
Age	1.00															
Gender	-0.12	1.00														
Education	-0.07	-0.03	1.00													
Income	-0.02	-0.37	0.21	1.00												
ftp1	0.13	-0.05	0.03	0.14	1.00											
ftp2	0.08	-0.09	0.06	0.16	0.58	1.00										
ftp3	0.10	-0.09	0.04	0.16	0.48	0.59	1.00									
rgc1	0.29	-0.07	-0.07	0.08	0.33	0.29	0.22	1.00								
rgc2	0.15	-0.05	-0.01	0.14	0.28	0.30	0.31	0.48	1.00							
rgc3	0.29	-0.10	-0.05	0.10	0.40	0.33	0.32	0.48	0.47	1.00						
frpa1	0.15	-0.09	0.04	0.18	0.23	0.21	0.25	0.27	0.43	0.28	1.00					
frpa2	0.21	-0.12	0.09	0.22	0.22	0.24	0.23	0.29	0.33	0.30	0.64	1.00				
frpa3	0.21	-0.12	0.09	0.21	0.25	0.26	0.27	0.31	0.41	0.30	0.62	0.66	1.00			
prsa1	0.21	-0.09	0.07	0.27	0.26	0.20	0.22	0.12	0.19	0.26	0.21	0.26	0.28	1.00		
prsa2	0.14	-0.11	0.07	0.33	0.26	0.27	0.29	0.15	0.34	0.26	0.32	0.31	0.34	0.61	1.00	
prsa3	0.17	-0.11	0.06	0.32	0.25	0.20	0.23	0.13	0.20	0.25	0.27	0.34	0.34	0.68	0.63	1.00

Notes: FTP = Future Time Perspective, RGC = Retirement Goal Clarity, FRPA = Financial Retirement Planning Activities, PRSA = Perceived Retirement Savings Adequacy. SD stands for Standard Deviation.
Source: Authors' elaboration.

workers. These cases were handled using full information maximum likelihood (FIML).

To test the mediation hypothesis, Monte Carlo confidence intervals (CIs) were computed for direct path, indirect path (via the mediators) and total path effect (Preacher and Selig, 2012) using the function monteCarloCI from the semTools package (Jorgensen et al., 2018). To test the hypotheses on differences between employment status groups, Monte Carlo confidence intervals for each group were computed. Overlapping CIs suggest that differences between groups are not statistically significant.

As is common practice in SEM methodology, the absolute and relative model fit was reported. Given that the sample size in this study is large, fit indexes that were resistant to large N samples were used (West, Taylor and Wu, 2012). These include three indexes: the Root Mean Squared Error of Approximation, or RMSEA (Steiger, 1990), Tucker-Lewis Index, or TLI (Tucker and Lewis, 1973), and Comparative Fit Index, or CFI (Bentler, 1990).[6]

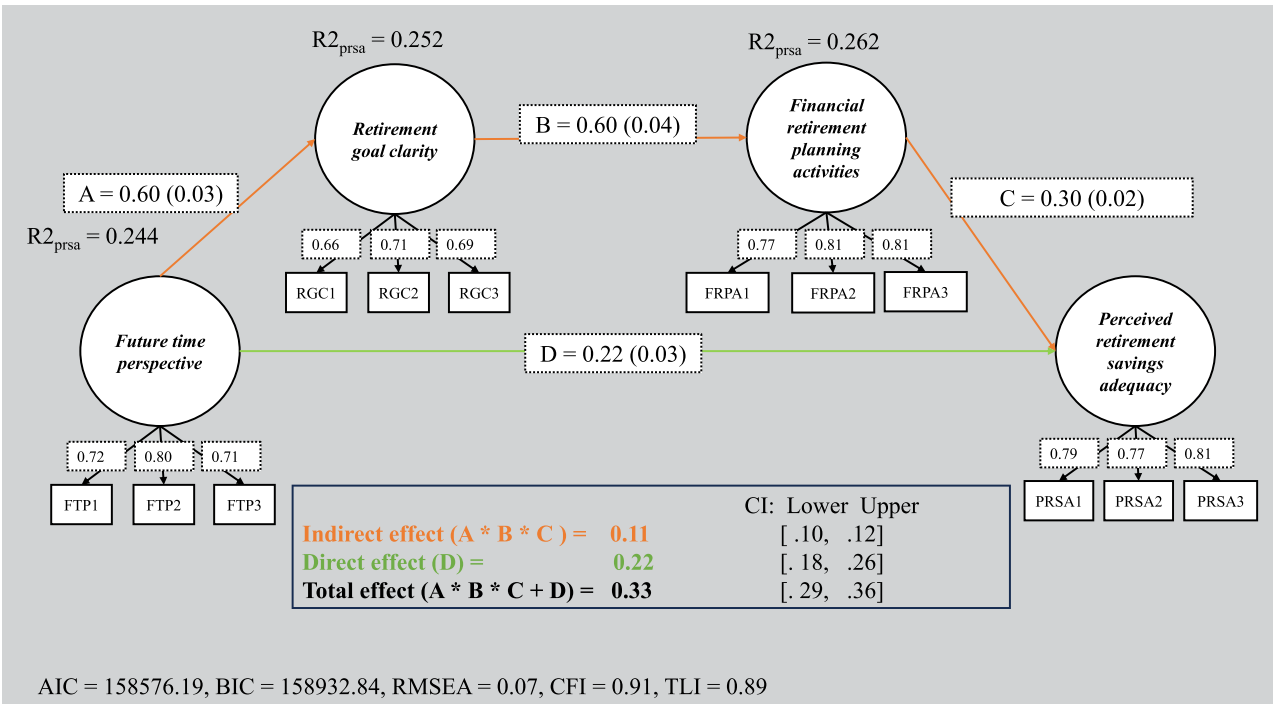
Results

Descriptive statistics

Table 1 shows descriptive statistics of all the study variables, by employment status. We find that most self-employed workers are voluntary (60 per cent), followed by those who are forced (21 per cent) or natural (19 per cent). Employees and the different groups of self-employed workers appear similar in terms of age and gender composition. All groups of self-employed workers have higher educational attainment, on average, compared to employees. However, the average income level seems to be the highest for employees, followed by voluntary self-employed workers, and finally forced and natural self-employed workers. Moreover, on average, different groups of solo self-employed workers would appear to feel less prepared for retirement than do employees. For instance, the average of PRSA3 (measuring perceived retirement savings adequacy) is 3.42 (SD = 0.97) for employees and 3.07 (SD = 1.12) for voluntary self-employed workers, but only 2.78 (SE = 1.14) for the natural self-employed group and 2.75 (SE = 1.24) for the forced self-employed group.

6. Guidelines for a good model fit are established as <0.06 for RMSEA, and >0.95 for CFI and TLI (West, Taylor and Wu, 2012).

Figure 1. *Standardized coefficients of path model (Model 2)*



Notes: Standard errors in brackets. R2 = variance of PRSA explained by including the predictor. SSE stands for Solo Self-employed. FTP = Future Time Perspective, RGC = Retirement Goal Clarity, FRPA = Financial Retirement Planning Activities, PRSA = Perceived Retirement Saving Adequacy. Results are controlled for age, gender, education and income.
Source: Authors' elaboration.

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SEM analysis

First, a model with future time perspective as the only main predictor of perceived retirement savings adequacy (including controls) was estimated. The results show a strong, positive relationship (β = 0.44; 95% C.I. [L.L.] = 0.38; 95% C.I. [U.L.] = 0.50; RMSEA = 0.057; CFI = 0.963; TLI = 0.948). Hence Hypothesis 1, suggesting that future time perspective is positively related to perceived retirement savings adequacy, is supported.

Second, a model with future time perspective predicting perceived retirement savings adequacy and mediated by retirement goal clarity and financial retirement planning activities was estimated (see Figure 1). The indirect effect of future time perspective on perceived retirement savings adequacy is positive and statistically significant (β = 0.11, 95% C.I. [L.L.] = 0.10, 95% C.I. [U.L.] = 0.12; RMSEA = 0.07, CFI = 0.91, TLI = 0.89), suggesting that retirement goal clarity and financial retirement planning activities mediate the relationship between future time perspective and perceived retirement savings adequacy. Hence, Hypothesis 2 is supported. However, it should be noted that the mediation is only partial. When taking the mediators into account, the direct effect of future time perspective on perceived retirement savings adequacy remains statistically significant (β = 0.22, 95% C.I. [L.L] = 0.18, 95% C.I. [U.L.] = 0.26).

Third, the previous model was estimated for all studied employees and voluntary, natural, and forced solo self-employed workers, and coefficients were allowed to vary (RMSEA = 0.07, CFI = 0.90, TLI = 0.89). Model estimates and CIs of direct and indirect effects of future time perspective through retirement goal clarity and financial retirement planning activities for the different employment status groups are shown in Table 3. All effects are statistically different from zero for employees and voluntary, natural, and forced solo self-employed workers. Retirement goal clarity and financial retirement planning activities partially mediate the relationship between future time perspective and perceived retirement savings adequacy among all groups. The *indirect* effects do not differ significantly between groups.

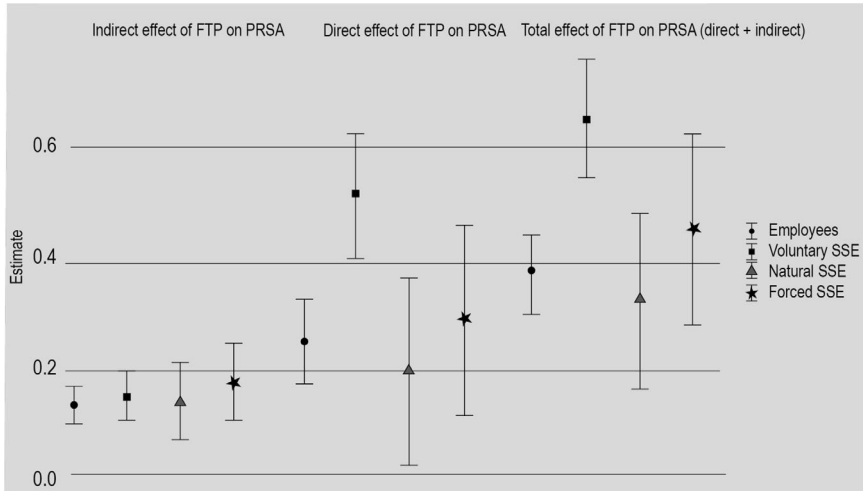
In contrast, the strength of the remaining *direct* effect of future time perspective on perceived retirement savings adequacy does differ between the employment status groups. It is significantly higher for voluntary solo self-employed workers compared to employees ($B_{voluntarySSE}$ = 0.50, 95% C.I. [L.L.] = 0.39, 95% C.I. [U.L.] = 0.61; $B_{employees}$ = 0.24, 95% C.I. [L.L.] = 0.17, 95% C.I. [U.L.] = 0.32). This also applies for voluntary solo self-employed workers compared to natural solo self-employed workers ($B_{naturalSSE}$ = 0.19, 95% C.I. [L.L.] =0.02, 95% C.I. [U.L.] = 0.36). Similar results hold for the total effect of future time perspective on perceived retirement savings adequacy ($B_{voluntarySSE}$ = 0.64, 95% C.I. [L.L.] = 0.54, 95% C.I. [U.L.] = 0.75; $B_{employees}$ = 0.37, 95% C.I. [L.L.] =0.30, 95% C.I.

Table 3. *Unstandardized path coefficients and Monte-Carlo 95% C.I.'s of Model 3*

Employment status	Indirect effect of FTP on PRSA (through RGC and FRPA)			Direct effect of FTP on PRSA			Total effect of FTP on PRSA		
	B	95% C.I. L.L.	95% C.I. U.L.	B	95% C.I. L.L.	95% C.I. U.L.	B	95% C.I. L.L.	95% C.I. U.L.
Employees	0.12	0.09	0.16	0.24	0.17	0.32	0.37	0.30	0.44
Voluntary SSE	0.14	0.10	0.19	0.50	0.39	0.61	0.64	0.54	0.75
Natural SSE	0.13	0.07	0.20	0.19	0.02	0.36	0.32	0.16	0.48
Forced SSE	0.16	0.10	0.24	0.28	0.11	0.45	0.44	0.27	0.62

Notes: SSE stands for Solo Self-employed. FTP = Future Time Perspective, RGC = Retirement Goal Clarity, FRPA = Financial Retirement Planning Activities, PRSA = Perceived Retirement Savings Adequacy, C.I. = Confidence Interval, L.L. = Lower Limit. U.I. = Upper Limit.
Source: Authors' elaboration.

Figure 2. *Unstandardized path coefficients and 95% Monte Carlo C.I.'s of Model 3*



Notes: SSE stands for Solo Self-employed. FTP = Future Time Perspective, RGC = Retirement Goal Clarity, FRPA = Financial Retirement Planning Activities, PRSA = Perceived Retirement Savings Adequacy. C.I. = Confidence Interval. Fit indexes: AIC = 158576.19, BIC = 158932.84, RMSEA = 0.07, CFI = 0.91, TLI = 0.89.
Source: Authors' elaboration.

[U.L.] = 0.44; $B_{naturalSSE}$ = 0.32, 95% C.I. [L.L.] =0.16, 95% C.I. [U.L.] =0.48). All in all, these results provide partial support for Hypothesis 3. For a visualization of these findings, see Figure 2.

Sensitivity checks

Some sensitivity checks were conducted to test the robustness of the findings. First, we tested whether the results were driven by differences in financial knowledge between groups, given that the retirement preparation literature indicates financial knowledge to be an important precursor of financial retirement planning (Lusardi and Mitchelli, 2007). However, controlling for this did not change our main findings.[7] Moreover, we ran a sensitivity check excluding those workers who combine salaried employment and self-employment, as an even more strict test of our theoretical expectations. Also in this case, the main conclusions were not affected.[8]

7. This article is supplemented by an online Appendix developed by the authors and made available to readers (see Supporting information). See Appendix A.2a and Appendix A.2b.
8. This article is supplemented by an online Appendix developed by the authors and made available to readers (see Supporting information). See Appendix A.3a and Appendix A.3b

Discussion

Financial retirement planning is important for people to ensure an adequate standard of living during retirement. Previous research on financial retirement preparation has mainly focused on employees and rarely considered different types of workers, such as self-employed workers. In the current study, a financial retirement planning model inspired by Hershey, Henkens and van Dalen (2007, 2010) was tested between employees and different types of solo self-employed workers in the Netherlands. This country provides an interesting context to study differences in retirement preparation processes between solo self-employed workers and employees. Whereas retirement financial planning decisions are rather centralized for most workers, self-employed workers have a great deal of individual responsibility to prepare for their retirement. As such this study aimed to improve our understanding of the situational contingency of psychological retirement preparation mechanisms. Based on image theory and situational strength theory, it was expected that the effect of future time perspective on perceived retirement savings adequacy – mediated by retirement goal clarity and financial retirement planning behaviours – would be the highest for voluntary solo self-employed workers, followed by natural and forced solo self-employed workers, and employees.

Findings from the SEM analysis support the proposed model of financial retirement planning. For all studied groups of workers, future time perspective is positively associated with perceived retirement savings adequacy through retirement goal clarity and engagement in financial planning activities. These findings are in line with Hershey, Henkens and van Dalen (2007, 2010) and provide further support to image theory (Beach and Mitchell, 1987) applied to the retirement planning context. Workers who are future-oriented are more inclined to formulate clear retirement goals, which consequently result in greater retirement planning behaviour and a higher level of perceived adequacy of retirement savings. It should be noted, however, that the relationship between future time perspective and perceived retirement savings adequacy can only partly be explained by the studied mediators. The remaining direct relationship between future time perspective and perceived retirement savings adequacy, which has also been observed in a few earlier studies (e.g. França and Hershey, 2018), suggests that this construct does not only guide financial preparation behaviours but also shapes the appraisal of the future financial situation. Another interpretation of this remaining direct relationship is that there are also other mechanisms that link this personality construct to perceived retirement savings adequacy. Research has shown that future time perspective is associated with many different outcomes. For example, higher future time perspective scores are positively associated with well-being and negatively with risk-taking behaviour (Kooij et al., 2018). For future research it may be relevant to explore such potential alternative mechanisms further.

Based on situational strength theory (Meyer, Dalal and Hermida, 2010) it was expected that individual personality traits such as being forward-looking (directly, and indirectly mediated by retirement goals and financial planning activities) will be more strongly related to perceived retirement savings adequacy in some contexts or groups than others. Earlier research has shown that in the United States, where workers have a lot of individual responsibility to prepare for retirement (i.e. a "weak" situational context), the relationships were more visible than in the supportive (i.e. "strong") Dutch setting (Hershey, Henkens and van Dalen, 2007; Hershey, Henkens and van Dalen, 2010). The findings of the current study add to these previous results, by showing that the strength of the relationships also varies across employment status groups facing different pension regimes within a single country context. Even though the indirect effects did not differ between groups, the findings show that the direct effect of future time perspective on perceived retirement savings adequacy is more powerful for voluntary self-employed workers in the Netherlands (who face a relatively "weak" situational context of retirement preparation) as compared to Dutch employees. Employees face a relatively "strong" situational context of retirement preparation in the Netherlands given their automatic enrolment in employer-sponsored pensions, while solo self-employed workers are seen as entrepreneurs and, as such, are expected to be self-reliant in terms of pension preparation (Cieślik and van Stel, 2024). As suggested by situational strength theory, stronger situations can be expected to "attenuate the subsequent trait–-outcome relationship" (Meyer, Dalal and Hermida, 2010, p. 122). For employees, therefore, their personal outlook on the future seems to matter less for their perceived retirement preparedness than is the case for solo self-employed workers.

Also, for natural solo self-employed workers, it is observed that the direct effect of future time perspective on perceived retirement savings adequacy is weaker than among voluntary solo self-employed workers. For the forced solo self-employed group, the findings point in a similar direction but were not statistically significant. For these groups, however, this may reflect a more precarious situation. As the descriptive statistics for perceived retirement savings adequacy show: employees score highest on perceived preparedness, followed by voluntary solo self-employed workers, and thereafter the natural and forced groups. As such, for natural and forced self-employed workers, their perceived retirement preparation outcomes seem to suggest that these workers are aware that they will have inadequate retirement incomes. While we know that some workers may be overly optimistic about their retirement savings (Kim and Hanna, 2015), the patterns in our study may suggest rather realistic perceptions, which reflect the structural disadvantages facing self-employed workers in the Netherlands, especially for those who entered this form of work out of necessity. Moreover, being forward-looking does not seem to help them as much in preparation as is

the case among the voluntary self-employed group. In particular, the "natural" group shows similar patterns to employees, with the difference being that they have a far greater responsibility to plan for their own retirement, and the consequences of not doing so are much more severe than for salaried workers. Even if our results are controlled for income, it still may be that daily tasks and challenges connected to self-employment may prevent them from planning how to finance their retirement. For policy discussions about retirement preparation of self-employed workers, this highlights the importance of taking into account the distinction between "opportunity versus necessity entrepreneurship" (Fairlie and Fossen, 2020).

It should be noted that the current measure of perceived retirement savings adequacy may not fully capture all potential ways in which self-employed workers could prepare for old age. Research among self-employed workers has shown that they may count on working longer than employees (van Dalen, Damman and Henkens, 2022; Zwier, Damman and Van Den Heuvel, 2020), which might be considered a strategy to finance one's retirement. Moreover, previous research shows that self-employed workers tend to invest in free assets, including real estate investments (Mastrogiacomo and Alessie, 2015; Zwinkels et al., 2017), which may also offer financial resources. Also, strategies that self-employed people might rely on at the household level may play a role, such as a partner's income. While these mechanisms might be at play, they all face risks, such as longevity risk and the risk of encountering life events (e.g. being unable to work due to illness). For future research it would be relevant to take an even broader perspective on financial preparation for retirement and examine whether types of preparation and their antecedents differ between employees and diverse solo self-employed workers.

When interpreting the research findings, several study limitations should be taken into account. First, the data are not representative of the Dutch working population. For instance, the respondents in the sample are relatively highly educated. Second, the data were collected during the COVID-19 pandemic, which may make them less generalizable to other historical periods. It could have been the case that respondents were more worried about their financial future, than they would have been in other periods. Third, given the cross-sectional nature of the data, only associations between variables could be examined. We cannot draw conclusions about causality. Finally, the study is limited to the Dutch context, and the findings will not necessarily be generalizable to other country contexts, due to institutional differences that may affect the strength of the psychological mechanisms at play. The Dutch context offers a relevant setting though to examine the situational strength hypothesis across employment status groups. For future research, we would encourage to further examine questions related to the situational contingency of retirement preparation mechanisms, for

instance, by comparing country contexts, or by examining groups that face different pension policies within countries.

Nevertheless, by conducting this investigation, a contribution to the scientific retirement planning literature was made by extending existing theoretical insights (van Dalen, Henkens and Hershey, 2010; Hershey, Henkens and van Dalen, 2007; Hershey, Henkens and van Dalen, 2010) to self-employed workers, by distinguishing between different types of solo self-employed workers (e.g. including the "natural" group), and by applying the situational strength framework to deduce group-specific hypotheses. This study shows that the link between future time perspective and perceived retirement savings adequacy is the strongest for voluntary self-employed workers, compared to natural self-employed workers and employees. Also, this study adds to the current policy debate on the social insurance of solo self-employed workers. Previous research shows that this group is heterogeneous and may hide precarious employment situations (Boeri et al., 2020; Conen, Schippers and Schulze Buschoff, 2016; Visser, Damman and Kraaykamp, 2024). In the Dutch context, there is a specific concern for self-employed workers as they are not automatically enrolled in pension funds as is the case for employees (Zwinkels et al., 2017). The current article highlights the importance for governments and policy makers involved in the design of pension systems of taking the heterogeneity between self-employed workers into account, since workers who have not consciously chosen self-employment may fare less well as compared to their voluntary counterparts. This may not only have implications for their individual well-being in old age, but – in light of the flexibilization of labour markets – may also have consequences for society at large.

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Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Early pension withdrawals and their uneven long-term effects in Peru

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Abstract This article examines the potential impact of early pension withdrawals from Peru's individual retirement account system. Originally introduced as a policy response to the COVID-19 pandemic, a number of large withdrawals were allowed during and after the pandemic. We find that these policies can reduce expected pension wealth by about 40 per cent, but there are important heterogeneous effects. There is a socio-economic gradient in the distribution of pension fund losses, with individuals at the lower end of the income or savings distribution experiencing larger losses. Losses are also higher for men and older people, who have less time to rebuild their pension pots.

Keywords old-age benefit, old-age risk, pension fund, payment of benefits, older people, gender, Peru

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Introduction

One of the most recent controversial pension policies is the early withdrawal of pensions, which was introduced to smooth the economic shock caused by COVID-19. A review by Madeira (2024) shows that at least 31 countries have implemented this policy. While for some countries these measures were targeted, reason-specific and a one-off policy, for others the measure was broad, allowing unconditional withdrawals well beyond the scope of the measures designed to combat the economic crisis caused by the pandemic. Peru is illustrative of this latter category of countries, having permitted up to seven early pension withdrawals (the majority of which were unconditional) between 2020 and 2024. The amount withdrawn from all these policies has reached around 13.0 per cent of GDP. This study focuses on the first five policies, which occurred very close together and were concentrated between April 2020 and May 2021, with a total withdrawal of 8.3 per cent of GDP.[1]

The effects of early pension withdrawals have only recently begun to receive attention in the literature. For instance, Lorca (2021) shows that early pension withdrawals in Chile may result in a 7.3 per cent reduction in monthly pension benefits, as well as an exacerbation of income inadequacy and inequality in retirement. This, in turn, could lead to a 4.3 per cent rise in government expenditure, with the introduction of additional social pension benefits to offset the reduction in savings experienced by retirees. Madeira (2022) uses a life-cycle model to show that pension withdrawals in Chile could reduce the savings rate of the economy by 1.7 per cent and 2.3 per cent for the average household. The study also quantifies some potential policies to offset these effects, such as increasing the retirement age, personal pension contributions and public expenditure on social pensions. While the average losses in contributory pensions could be 27.9 per cent in Chile due to pension withdrawals, a 2022 reform strengthening social pensions may reduce the average loss to 6.2 per cent (Madeira, 2024). Furthermore, the Chilean case is analysed in depth in Fuentes, Mitchell and Villatoro (2023), with a particular focus on the underlying factors that led to individuals opting to withdraw their pension funds. The authors highlight that the withdrawal design, which includes lower and upper monetary limits on withdrawals, has resulted in a range of withdrawal patterns across different groups of individuals. For instance, those with lower incomes, those who have made fewer contributions, younger individuals and women are likely to be the most adversely affected by the withdrawal policies.[2]

1. For Chile, withdrawals represented 14.1 per cent of GDP (Fuentes, Mitchell and Villatoro, 2023), while for Australia it was 2.0 per cent of GDP (Hamilton et al., 2023). For other emerging economies, the average was 4.4 per cent, according to Fuentes, Mitchell and Villatoro (2023).
2. Also in Chile, López and Rosas (2022) analysed public attitudes towards early pension withdrawals and found that support for this policy may be driven by lack of confidence in institutions.

Another country where some recent studies have looked at early pension withdrawals is Australia. Bateman et al. (2023) found that most people cited urgent needs as the reason for withdrawing immediately and about a quarter cited anticipation of future needs. The authors point out that individuals made decisions very quickly (about a week), withdrew as much as they could and appeared to underestimate the impact of withdrawals on their pension funds. They also found support for the importance of precautionary liquidity, captured by a higher probability of withdrawal among individuals who were more uncertain about future circumstances and job prospects. For Wang-Ly and Newell (2022), the early withdrawal policy in Australia seemed to have achieved the objective of targeting those who were more financially vulnerable before the pandemic.

Most of the evidence on the effects of early access to pension savings is concentrated in Chile and, to a lesser extent, Australia. The present analysis on Peru contributes to this body of evidence by focusing on estimating and examining potential long-term effects on pension wealth and the distribution of losses along the distribution of pension savings and income. All this is made possible through the use of administrative micro-data through simulations. An early study on Peru is Bosch et al. (2020), but they simulate with highly stylized scenarios the expected changes in replacement rates caused by a hypothetical withdrawal policy of 25 per cent of pension savings. They show, for example, that the replacement rate could fall by 13.1 per cent for individuals withdrawing 25 per cent of their pension balances at age 40 (at a real interest rate of 3.5 per cent).

We simulate the future pension savings of participants in the Peruvian Private Pension System (SPP), a pension system based on individual retirement accounts. To do this, we simulate what these savings would be with and without the early withdrawal policy. The comparison of these distributions with the counterfactual distributions allows us to estimate the potential impact of these policies, both overall and for specific groups. We find that, on average, there is an expected reduction of around 40 per cent in the pension funds accumulated at retirement age, although there are significant heterogeneous effects. For example, there is a marked socio-economic gradient in the distribution of pension fund losses. Losses are higher for participants at the bottom of the income or pension wealth distribution. Moreover, older people suffer greater losses than younger people because they have less time to rebuild their pension pots. Men's pension funds fall by 41.1 per cent, while women's pension funds fall by 38.9 per cent.

Although the main reason given by the authorities for implementing the withdrawal policies was to provide liquidity to families due to the job losses and economic crisis generated by the pandemic, there are at least two reasons why this policy may be problematic and ill-designed (Olivera, 2021). First, pension funds are left severely reduced or even depleted, particularly for affiliates with

small pension balances, which will reduce resources to finance an adequate standard of living during old age. Unlike many other countries, Peru does not have a universal social pension that could attenuate the risk of falling into poverty in old age. Second, the withdrawal policies are not targeted on families suffering more adverse conditions, as was mentioned in the arguments for the measures. The eligibility conditions are very loose so that practically any affiliate can draw down cash funds, regardless of the size of the pension balance or income levels.

It could be argued that the funds were important to allow families to cope with income losses, but the affiliates of the SPP are mostly salaried workers in the formal labour market with higher educational attainment and job quality higher than the average worker in the Peruvian labour market. SPP affiliates (particularly those contributing regularly) tend to be richer, so that they suffered less the economic consequences of the pandemic or had other resources to cushion the shocks. Thus, allowing pension fund withdrawals may not be a strictly needed policy in the Peruvian context.

The rest of the article is organized as follows. The next section presents the institutional background and the early pension withdrawal policies. Thereafter, we present the data and our simulation methods before presenting and discussing the results. Finally, we offer our conclusions.

Institutional background

The pension system

The Peruvian pension system is organized as a parallel system, that is, individuals must choose between two alternative pension systems. First, the Private Pension System (SPP), which is a defined contribution (DC) system based on individual retirement accounts, introduced in June 1993. The creation of this type of system was part of a wave of pension reforms inspired by the Chilean example that spread widely across Latin America during the 1990s. The pension fund managers (*Administradoras de Fondos de Pensiones* – AFP) are companies that receive the pension contributions and invest the individualized savings. There are currently four AFPs in Peru: Prima, Integra, Profuturo, and Habitat.[3] Their investments

3. Other AFPs previously operated, but they gradually left the market or merged with other companies over time. Furthermore, each AFP offer four alternative pension funds with different risk compositions. See footnote 4.

are tightly regulated by the Superintendent of Banking, Insurance and Pension Funds (SBS).[4]

Second, the National Pension System (SNP), which is a defined benefit (DB) system that operates as a pay-as-you-go (PAYG) pension system with worker contributions and additional government transfers to support the payment of pensions. Pension participants can change from the SNP to the SPP at any time, but the reverse is not possible.[5]

By law, formal-sector workers on the payroll are required to pay social security contributions, including pension contributions. Contributions are voluntary for self-employed workers and other types of workers. Given the large size of the informal labour market in Peru, the coverage and contribution frequency of the pension system is low. In 2021, 47 per cent and 27 per cent of the workforce were covered by the SPP and SNP, respectively. However, these figures fall to 20 per cent and 8 per cent, respectively, when only regular contributors are considered. Thus, while about three-quarters of the workforce may be covered by a pension scheme, only one-quarter of the workforce is expected to be able to receive an old-age pension.

There is no minimum pension guarantee in the SPP, except for a special cohort of members (born before 1945) who have changed systems in the past. The pension is calculated solely on the final pension balance and, for some participants, a "recognition bond".[6] In addition, following a major change in June 2016, members can withdraw up to 95.5 per cent of their pension pot (tax-free) at retirement, while the remaining 4.5 per cent is transferred to the health insurance system (EsSalud), which provides health insurance to retirees. It is still possible for individuals to choose to buy an annuity on the market or to withdraw a smaller percentage of their pension savings, but in practice most people withdraw the maximum amount possible. Between 2016 and 2019, out of a total of 241,200 eligible individuals (aged 62 or older in 2016), only 4,036 individuals (1.7 per cent) opted for an annuity.

SNP benefits are calculated according to pension rules that include minimum and maximum pension amounts. The minimum pension is granted if the

4. Fund type 0 is designed to maintain capital, offers both very low return and volatility, and is intended for individuals who are in the process of retiring. Fund type 1 involves investments with relatively low returns and volatility and is mandatory for individuals aged 60–65, unless they have expressly chosen to be assigned to fund type 0 or 2. Fund type 2 includes investments with moderate growth and volatility and combines both fixed-income instruments and equities. Fund type 3 is generally composed of investments with higher returns and volatility, such as equities.

5. People who have contributed to the SNP before joining the SPP can claim part of their contributions in the form of a "recognition bond". The initial value of this bond depends on the number of contributions and the individual's salary. Each month, the value is updated with the consumer price index. To date, there are three types of bonds, issued from 1992, 1996, and 2001.

6. See footnote 5.

member has at least 20 years of contributions, but this criterion has been relaxed from October 2021 to allow the payment of two types of pension at lower amounts. If the person has at least 20 years of contributions, the maximum and minimum retirement pensions in the SNP are 893 soles and 500 soles (PEN) per month (equivalent to 87 per cent and 49 per cent of the minimum wage in 2022). With at least 15 years of contributions, the pension is PEN 350; with at least 10 years of contributions, the pension is PEN 250 (see Valderrama, 2024).

The retirement age is 65 in both the SPP and the SNP. Contributions are paid on the monthly salary, which cannot be less than the official minimum wage (PEN 1,025 as of May 2022). The total contribution rate in the SNP is 13 per cent. In the SPP, the contribution rate to individual pension accounts is 10 per cent of the total salary, and the insurance premium fee is 1.74 per cent of the salary (up to a maximum salary of PEN 10,535). Following a reform implemented in 2013 (see Bernal and Olivera, 2020), some SPP members pay a load factor fee (a percentage applied to the salary), while others pay a balance fee (a percentage applied to the pension balance). The average pension fund management fee in the SPP is 1.58 per cent of salary for members in the load factor fee scheme, and it is 1.12 per cent of balance for members in the balance fee scheme.[7] Taking into account all contributions and fees on wages, affiliates in both systems contribute roughly similar percentages, i.e. 13 per cent in the SNP and 11.9–13.3 per cent in the SPP.

Peru also has a non-contributory pension programme that targets the extremely poor elderly who are aged 65 or older and do not receive any type of pension. The *Pension 65* programme has about 570,000 recipients, or about 19 per cent of the population aged 65 or older, and the fiscal cost is about 0.11 per cent of GDP. This is the second largest social programme in Peru, after the conditional cash transfer programme, *Juntos*. On a monthly basis, the transfer of *Pension 65* is equivalent to PEN 125 (the transfer is collected every two months), which corresponds to 66 per cent of the extreme monetary poverty line in Peru in 2020 and is equivalent to about 33 US dollars (USD).[8]

Pension withdrawal policies

Despite the existence of seven distinct early pension withdrawal programmes between April 2020 and June 2024, this study concentrates on the initial five, which occurred in close succession and were concentrated between April 2020 and May 2021. The main reason given by the Peruvian government and/or

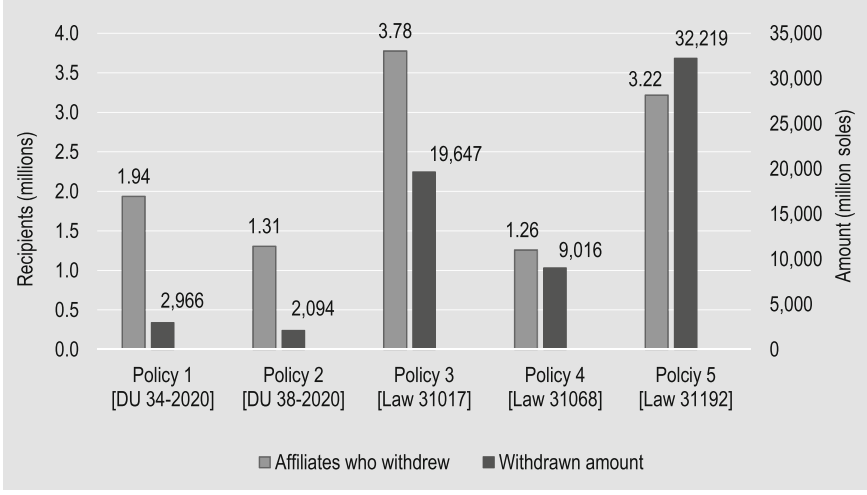
7. In addition to the balance fee, members in this scheme must pay a decreasing load factor fee from 2013 to 2023. On average, this additional fee will be 0.17 per cent of salary from December 2021.
8. We use an exchange rate of PEN 3.80 per USD 1.00.

Congress was the need to mitigate the economic impact of the COVID-19 pandemic. Figure 1 reports the amounts withdrawn and the number of recipients for each of these policies.

The initial two policies were formulated and implemented by the government, while the subsequent policies were devised and enacted by Congress. The first policy (Emergency Decree DU 034-2020) permitted withdrawals from pension funds of up to PEN 2,000 for affiliates who had not contributed between September 2019 and February 2020. This ceiling was equivalent to 2.2 minimum wages at the time of the policy (approximately USD 526). The second policy (Emergency Decree DU 038-2020) permitted withdrawals of up to PEN 2,000 for affiliates who met at least one of the following criteria: i) those placed under temporary job retention schemes financed by the Government; ii) those who did not contribute in February or March 2020; and iii) those whose wages were below PEN 2,400 and contributed in February or March 2020. The benefits of these policies were exclusive, such that they were not accumulative.

The Congress of Peru was responsible for the design and enactment of all subsequent early pension withdrawal policies. The third policy (Law 31017) permitted individuals to withdraw up to 25 per cent of their pension funds, with a minimum and maximum limit of PEN 4,300 and PEN 12,900. In contrast to

Figure 1. *Early pension withdrawal policies (number of recipients and amounts)*



Notes: The darker coloured bars measure the number of individuals who opted to withdraw pension funds (expressed in millions) and the lighter coloured bars show the total amount withdrawn, expressed in millions of soles (PEN). The data are taken from SBS (2022).
Source: Authors' elaboration.

Table 1. *Distribution of pension withdrawals*

Withdrawals	Affiliates		Million soles (PEN)		Average
	Number	%	Amount	%	(soles)
<2,000 soles	1,500,484	26.4	1,277	1.9	851
2,000-5,000	1,091,777	19.2	3,647	5.5	3,341
5,000-10,000	725,244	12.7	5,254	8.0	7,245
10,000-20,000	942,435	16.6	14,061	21.3	14,920
20,000-30,000	768,813	13.5	19,187	29.1	24,956
>30,000	662,725	11.6	22,516	34.1	33,975
Total	5,691,478	100.0	65,942	100.0	11,586

Notes: The table use data extracted from SBS (2022) and reports data as of December 2021. The withdrawal brackets indicate the accumulated withdrawals for each individual.
Source: Authors' elaboration.

previous policies, all SPP participants were eligible, irrespective of other governmental policies. The fourth policy (Law 31068) permitted withdrawals of up to PEN 17,200 for affiliates who had not contributed between October 2019 and September 2020, and withdrawals of up to PEN 4,300 for affiliates who had not contributed in October 2020. Finally, the fifth policy (Law 31192) permitted withdrawals of up to PEN 17,600 for all SPP participants without distinction.[9]

A total of 5,691,473 SPP participants withdrew their pension funds from at least one of the described pension withdrawal policies, with individuals withdrawing from every possible opportunity. The total amount of funds withdrawn as of December 2021 was PEN 65,942 million, representing approximately 8.3 per cent of GDP. An official report by Peru's Superintendency of Banking, Insurance and Pension Funds (SBS, 2022) details the main features of the withdrawal policies.

Figure 1 shows the amounts withdrawn from each policy. While the first two withdrawal policies involved PEN 2,966 million and PEN 2,094 million (4.5 per cent and 3.2 per cent of the total withdrawals), the remaining policies involved much larger amounts withdrawn from the pension funds. The third policy (Law 31017) implied a withdrawal of PEN 19,647 million (30 per cent), the fourth policy (Law 31068) allowed withdrawals of PEN 9,016 million (14 per cent), and the fifth policy (Law 31192) triggered the largest withdrawal with a total of PEN 32,200 million, representing 49 per cent of the total withdrawals.

9. The enacting dates for the early pension withdrawal policies were as follows: i) DU 034-2020: April 1, 2020; ii) DU 038-2020: April 13, 2020; iii) Law 31017: April 6, 2020; iv) Law 31068: November 4, 2020; and v) Law 31192: May 6, 2021.

Table 1 illustrates that the distribution of withdrawals is concentrated in small amounts. For instance, 45.6 per cent of these withdrawals are less than PEN 5,000, representing 7.4 per cent of the total amount withdrawn. Similarly, 25.1 per cent of the withdrawals are in excess of PEN 20,000, which accounts for 63.2 per cent of the total amount withdrawn. Of the affiliates who withdrew, 35 per cent made a single withdrawal, 37 per cent made two withdrawals, 19 per cent made three withdrawals, and 9 per cent made four withdrawals. Another noteworthy pattern is that the withdrawn funds of older affiliates are disproportionately represented in the distribution of withdrawal amounts. This is to be expected, given that older people tend to have larger pension pots.

Data and methods

Data

Our objective is to analyse the potential effects of the withdrawal policies on the level of expected pension balances. We do not use expected pensions as our main outcome because the SPP has practically ceased to provide pensions since 2016 due to a regulation abolishing the obligation to buy an annuity. Instead, the individuals can cash out up to 95.5 per cent of their pension funds at retirement age. However, by construction, the final pension balance is a measure directly linked with the level of a pension (which is equal to the pension balance divided by the annuity price).

For our simulations, we use a sample of the non-retired SPP population drawn from SBS administrative registers as of December 2019. This is a random sample, stratified and representative of the following strata: 5-year age groups, sex and year of enrollment in the SPP. This unique dataset includes information about individuals' pension balances, management fees, income, and various demographic variables. The sample represents 2 per cent of the total non-retired SPP population.[10] The initial sample size is composed of 138,020 observations, which corresponds to individuals older than age 18 and younger than age 65. We do not consider individuals older than age 65, as this is the legal retirement age. We drop observations with no information on residence region or living abroad (178), those who enrolled in the SPP before 18 years old (160), and those who are allocated in pension risk fund 0 (this type of fund is allocated to people in the process of retiring). The final sample size is 137,651 individuals.

The data include information on age, gender, employment condition, and income at the individual level. The data also include information about the

10. At a confidence level of 99 per cent, the sample size has a margin of error of 0.34 per cent.

pension account, such as enrollment date in the SPP, AFP firm, last contribution date, pension balance, balance affected and unaffected by the management fees reform, type of fee, type of pension risk fund, contribution density, and information about recognition bonds. This bond is an amount of money, based on past contributions, guaranteed by the government to those who were previously affiliated with the SNP.[11]

Simulation of pension withdrawals

We simulate the accumulation of pension funds for each individual of the sample from January 2020 until reaching retirement. Our sample was taken just before the onset of the pandemic (December 2019), and therefore it does not include information on whether the individual withdrew funds or on the size of each withdrawal. However, the available evidence (e.g. see SBS, 2022) and press releases from the SBS during 2020–2021 indicate that the majority of individuals decided to withdraw the maximum permitted amounts, even fully depleting their pension balance. Thus, we assume in our simulations that the selected and eligible individuals withdrew the maximum possible amount permitted by the policy, taking into account their own eligibility circumstances (pension fund size, wage, and contribution requisites).

As we do not know exactly which individuals decided to take up the withdrawal, we randomly select these people from the universe of affiliates fulfilling the eligibility conditions of a given policy. We use the available information about the number of affiliates withdrawing per age group and policy (reported by SBS, 2022) to randomly select individuals within each age group in our sample in order to obtain a proportion of affiliates withdrawing within each age group that is similar to the actual one. For the selected individuals, we compute a withdrawal value that is the maximum allowed by the policy and their own pension fund circumstances.

We set monthly periods for our simulation from t=1 to t=564, with t=1 equivalent to January 2020. The five withdrawal policies occurred between t=4 and t=20 with varying time windows to effectively claim and cash out the pension funds. In order to facilitate the simulations of pension fund accumulation and amounts withdrawn, we assume a unique period to compute the withdrawal for each policy. These periods are t=4 for policy 1; t=5 for policy 2; t=6 for policy 3; t=12 for policy 4; and t=20 for policy 5.

11. Olivera (2020) has used micro-data to study the ex-ante effects of a proposed multi-pillar pension reform, while Bernal and Olivera (2020) have used a similar sample (as of December 2016) to study the effects of the 2013 management pension fees reform.

The following equations allow us to compute the future streams of pension balance:

$$S_{t+1} = S_t(1 + r_t) + p_{t+1}c_{t+1}w_{t+1} \qquad if\ load\ factor\ fee \tag{1}$$

$$S_{t+1} = S_t^a(1 + r_t)(1 - a_{t+1}) + S_0(1 + r_t) + p_{t+1}c_{t+1}w_{t+1} \qquad if\ mixed\ fee \tag{2}$$

We denote S_t as the pension balance accumulated at period t, w_t is the real monthly salary, r_t is the real monthly return rate of pension funds, c_t is the contribution rate from the salary, and p_t is the probability of making pension contributions, which is proxied by the density of contributions observed for the individuals in our sample. The contribution density is the number of months with contributions over the total number of months participating in the SPP.[12] Depending on the type of fees assigned to individuals, their fund accumulation process will be different. Equation 1 shows the pension balance for the affiliates who pay load factor fees, which are charged on salaries and not on the balance. Equation 2 shows the pension balance for the affiliates who pay mixed fees, that is, paying both load factor fees and balance fees (a_t) over the pension balance accumulated since February 2013, which is the date of the pension fees reform. Thus, S_0 is the pension balance that is not charged with balance fees.[13]

The long-term value of the return rate of pension funds is a key variable affecting the accumulation of pension savings. We assume a real annual interest rate of 4.2 per cent, which is the value used by an International Monetary Fund (IMF) report (see Freudenberg and Toscani, 2019) to estimate future pensions in Peru. Among the arguments mentioned in that report for the choice of the return rate value are: i) the return rate should be close to real GDP growth in the long term, which is approximately between 3.5 per cent and 4 per cent according to IMF estimations before the COVID-19 pandemic; ii) the return should approach the performance of other pension funds with the best practices, such as the Norwegian Government Pension Fund Global which has a real long-term return of about 3.8 per cent; iii) pension funds around the world have moderated their expectations of return rates as the new normal, that is, lower than what was expected before the financial crisis of 2008; and iv) other studies such as the one

12. The individual contribution densities are adjusted to take into account that their registration has been available since May 2006. Moreover, the densities are also adjusted to take into account the lack of contributions between the last date of the contribution and December 2019.

13. According to this reform, the load factor fee component of the mixed fee regime will gradually reduce down to zero by January 2023, leaving the balance fee as the only fee for people under the mixed fee regime (see more details of this reform in Bernal and Olivera (2020).

by the OECD, IDB and World Bank (2014) have used net real rates of return of 3.5 per cent.[14]

Data from the statistics of SBS indicate that the average real return rate observed across monthly periods between 1994 and 2021 is 7.5 per cent, yet this value is 6.1 per cent for the last 5 years, and 4.1 per cent for the last 10 years. In Figure A.1 in the online Appendix, we report the evolution of the variation in the average SPP share price from December 1994 to December 2022.[15] It clearly shows a declining trend in the long term. The trend indicates that the nominal monthly rate is about 0.5 per cent, i.e. about 6 per cent annually. For our simulations, we include the actual values of return rates observed for each AFP and type of pension between January 2020 and December 2021, while the assumed annual return rate of 4.2 per cent starts from January 2022 onward.

The individuals also pay an insurance premium to private firms, but we do not include it in the simulation of pension balances as this is charged on the salary independently of pension contributions. The relevant fees for our simulation are the ones charged over the balance. We use the actual values of balance fees between January 2020 and May 2022, and then we assume the values of May 2022 for the next periods. These values are 1.25 per cent for Habitat, 0.79 per cent for Integra, 1.25 per cent for Prima, and 1.20 per cent for Profuturo.

The initial value of the salary is the last salary recorded in the sample. In case this does not correspond to the date of the sample draw (December 2019), we update the last recorded salary by inflation and salary premiums per cohort (5-year groups), sex, and contribution behaviour. We report these values in Table A.1 of the online Appendix while Table A.2 offers regression estimates.[16] We also impute salaries for 7.3 per cent of individuals in the sample for whom we do not have this information.[17] We assume in the simulations that the salaries grow according to the previously estimated premiums.

14. The Inter-American Development Bank's report (see Altamirano et al., 2018) estimates pensions and replacement rates for countries in Latin America and the Caribbean by using a real rate of return of 3.5 per cent. Studies by Altamirano et al. (2019), OECD (2019) and Álvarez et al. (2020), dedicated to studying the Peruvian case, also use a real rate of 3.5 per cent net of managing fees, yet the first study includes a sensitivity analysis with more optimistic rates of 5.5 per cent and 8 per cent, while the study by Freudenberg and Toscani (2019) includes a sensitivity analysis with a rate of 5.2 per cent.

15. This article is supplemented by an online Appendix developed by the authors and made available to readers (see Supporting Information) See Appendix, Tables A1-A.2 and Figures A1-A10.

16. See footnote 15.

17. The salary premiums are estimated with the median salaries by sex, birth cohorts, and contribution behaviour (i.e. whether the individual contributed in the sample year or not) in samples taken in 2015 (n=93,057), 2016 (n=97,562), and 2019 (n=117,941). The imputation uses the predicted values from the regression of the logarithm of salary against sex, recognition bond, decile of contribution density, type of administrative fee, AFP, type of pension risk fund, affiliation duration in the SPP, percentile of pension balance, age, age squared, and region.

In the simulation of equations 1 and 2, we also evaluate if the eligible individual has been randomly selected to cash out the funds involved in each policy at the periods in which the withdrawal must be computed (t = 4, 5, 6, 12, and 20). Equations 3 to 7 indicate that the withdrawal amount W_j is subtracted from the balance at the evaluation periods for each policy j. This amount is computed according to the rules of the policy and the available funds in the individual's account balance. The indicator functions I_j describe whether a given individual withdraws or not under policy j, that is I_j takes value one if $P_j = 1$, and zero otherwise. Note that policies 1 and 2 are mutually exclusive, while policies 3 and 5 are open for everyone. Thus, an individual could be eligible for more than one policy and make various withdrawals.[18]

$$S_{t+1} = S_t - I_1(P_1 = 1)W_1 \qquad evaluate\ at\ t = 4 \tag{3}$$

$$S_{t+1} = S_t - I_2(P_2 = 1)W_2 \qquad evaluate\ at\ t = 5 \tag{4}$$

$$S_{t+1} = S_t - I_3(P_3 = 1)W_3 \qquad evaluate\ at\ t = 6 \tag{5}$$

$$S_{t+1} = S_t - I_4(P_4 = 1)W_4 \qquad evaluate\ at\ t = 12 \tag{6}$$

$$S_{t+1} = S_t - I_5(P_5 = 1)W_5 \qquad evaluate\ at\ t = 20 \tag{7}$$

The baseline final balance S_b is computed solely with equations 1 and 2; that is, we obtain the balance assuming that no withdrawals take place. The estimated final balance after the policies, S_p, is computed with equations 1–7. We replicate 100 times the procedure of computing S_p and take averages of the results for each individual.[19] This could help to attenuate possible bias arising from our random selection choice of withdrawing individuals. We estimate the final effect of the policies as the percentage change in pension balances due to the policies (see equation 8).

$$D = 100 \times \left(S_b - S_p\right)/S_b \tag{8}$$

18. Note that the recognition bonds cannot be paid out as part of the withdrawals; these bonds are only paid by the Government when the individual retires or turns age 65. Thus, the withdrawal policies do not produce major disturbances in fiscal expenditures.

19. Figure A.2 in the online Appendix shows the total withdrawn amounts computed in all the 100 simulations for each policy and indicates low variation across the simulations. See footnote 15.

The next section describes the results of our simulations of this key outcome, both overall and across distinctive population groups.

Results

Overall results of simulations

Table 2 reports our overall simulations. We see that, in general, our results on the total amount of withdrawals and number of individuals cashing out funds are very close to the actual ones. For policies 1–4, the difference between the simulated and actual values of the withdrawn funds is about 4.1–5.4 per cent, yet for policy 5 this difference is 16.1 per cent. Overall, the difference between the simulated and actual values of the total amount of funds implied by the five policies is 7.4 per cent, and the difference is 2.7 per cent for the number of affiliates cashing out funds.

Our estimations indicate that the withdrawal policies will reduce the expected pension balances at retirement by 40 per cent (40.25 per cent on average, with 95 per cent confidence intervals of 40.09 and 40.42). We can also obtain different variations of D for each policy. Policy 1 reduces pension savings by 10.5 per cent, and policy 2 adds a further 5 per cent of loss. Thus, the two policies designed by the Government account for 15.5 per cent of the loss in future pension funds. Policy 3 adds 11.3 per cent of loss, policy 4 adds 4.6 per cent, and policy 5 adds 8.8 per cent. This implies that the withdrawal policies passed by Congress increased the losses from 15.5 per cent to

Table 2. *Simulation results*

Policy	Amount of withdrawals (millions of soles – PEN)		Affiliates with at least one withdrawal	
	Actual	Simulation	Actual	Simulation
Policy 1	2,966	2,806	1,910,843	1,898,050
Policy 2	2,094	2,140	1,296,323	1,296,050
Policy 3	19,647	19,712	3,746,482	3,746,350
Policy 4	9,016	9,389	1,250,250	1,250,050
Policy 5	32,219	27,029	3,206,818	3,206,550
Total	65,942	61,076	5,636,965	5,787,726

Notes: The actual amounts and number of affiliates correspond to individuals younger than age 65. Policy 1 refers to DU 34-2020, Policy 2 refers to DU 38-2020, policy 3 refers to Law 31017, policy 4 refers to Law 31068, and policy 5 refers to Law 31192.
Source: Authors' elaboration.

Table 3. *Affiliates with zero pension balance after withdrawing*

Policy	Affiliates	Percentage
(1) DU 34-2020	764,172	11.1
(2) DU 38-2020	386,658	5.6
(3) Law 31017	1,380,079	20.1
(4) Law 31068	890,682	12.9
(5) Law 31192	2,0914,88	30.4

Notes: The percentages are computed with respect to the total number of affiliates younger than age 65 as of December 2019.
Source: Authors' elaboration.

40.3 per cent (i.e. 24.7 percentage points). The next section deals with the assessment of these effects across various groups of individuals.

Table 3 reports our estimates about how many affiliates could have ended with a pension balance equal to zero after each withdrawal policy. The results indicate that the number of pension pots exhausted is considerable. For example, about 2 million affiliates could have a pension balance equal to zero after the last policy (policy 5), which represents 30 per cent of the total number of affiliates. Note that these pension accounts will still grow due to future contributions and capital returns, in particular for younger individuals. However, there is capital that will never be recovered, so that the levels of pension wealth will be lower in the future. A possible danger in the long run is a stronger demand for social pensions, but it is difficult to determine how strong this demand will be and how much could cost these social pensions. Considering the current level of the social pension in Peru of the *Pension 65* programme (PEN 125 a month targeted to extremely poor individuals with no pensions) we calculate that 62.5 per cent of SPP affiliates could have saved for a pension of at least the level of the social pension if no withdrawal policies would have been in place, but this percentage drops to 53.3 per cent after the policies.[20]

Heterogeneous effects of early withdrawals

We are interested in assessing the effects of the policy withdrawals across different groups and characteristics of the affiliates. An overall reduction of 40 per cent in the expected pension balance is already large enough to compromise old age

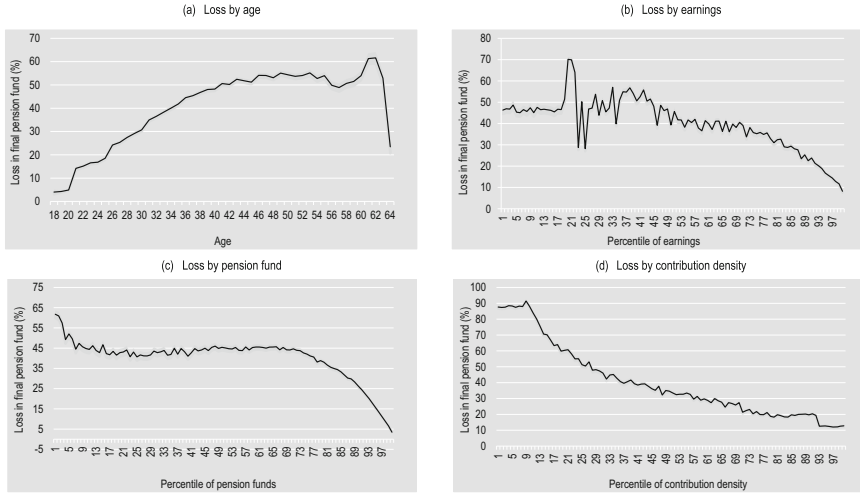
20. We use SPP's official life tables and an interest rate of 3 per cent to compute annuity prices for women and men at age 65. The annuity price is multiplied by the social pension amount, which results in the value of capital needed to finance a social pension. Then, we compare this amount with the final balance accrued by the individual.

security, but this figure could be larger or lower for some groups. Figure 2 and Figure 3 report the heterogeneous expected effects of the withdrawal policies.

Figure 2. *Losses in final pension fund due to withdrawals (%)*

Notes: The figure illustrates the loss in final pension balance due to withdrawals for various groups of individuals.
Source: Authors' elaboration.

Figure 3. *Losses in final pension fund due to withdrawals (%)*



Notes: The distributions of variables correspond to the values of 2019. The dark lines indicate the average loss in pension fund within the percentile. The grey area indicates 95 per cent confidence intervals.
Source: Authors' elaboration.

We observe in Figure 2 that the policies reduce more, albeit only slightly, the pension balances of men than those of women. The value of men's pension funds drop by 41.1 per cent while the value of women's pension funds drop by 38.9 per cent. When we compare women and men across ages, we observe that larger differences in losses (with men losing more than women do) occur at older ages. For example, women lose 0.5 per cent more than men in the age group 20–29, but men lose 3.4 per cent more than women in the group 50–59 (results not reported). Furthermore, people residing in regions other than the capital city, Lima, tend to experience higher losses (42.1 per cent against 38.0 per cent). There are also important differences across AFPs. The affiliates of Profuturo are those facing the largest losses at 53.4 per cent on average, while the affiliates of Habitat experience the smallest losses at 28.6 per cent on average. The reason is that Profuturo's affiliates tend to be the oldest, earning lower incomes and showing the lowest levels of contribution density. In contrast, Habitat's affiliates are the youngest in the sample. Thus, the withdrawal policies will hit this AFP harder, which has a relatively more vulnerable population.

The first panel of Figure 3 shows the impact of the withdrawals by age group. The loss of future funds is larger for older individuals and lower for younger individuals. The loss could be very high at 54.1 per cent for people aged between ages 46 and 55, but for the 21–25 age group, this is 16.5 per cent. The reason for these results is that older people have, on average, larger pension pots from which they can cash out more funds, and at the same time, they have less time to contribute, capitalize, and rebuild their pension funds. Our results also indicate that people close to retirement will experience a large drop in their expected funds. People aged between ages 60 and 64 will face a loss of 51.5 per cent in their pension balances. Of course, it is still possible that individuals withdrawing funds could make meaningful and well-informed investments and at least match the returns of the SPP, but anecdotal evidence suggests that the withdrawals increased conspicuous consumption (Olivera, 2021). Furthermore, the hypothesis that most people made savvy investments with the withdrawn funds is difficult to accept in a country where only 28 per cent of its adult population has the correct knowledge of simple financial questions about the interest rate, inflation, and risk diversification (Klapper, Lusardi and van Oudheusden, 2015).

The second panel of Figure 3 shows the losses in expected pension balances across the distribution of wages observed at the sampling draw (December, 2019). We observe that the lower deciles (poorer affiliates) experience, in general, larger losses than the higher deciles (richer affiliates), which indicates a clear socio-economic gradient in the effects of the withdrawals. For example, while the individuals in the poorest decile lose 47.9 per cent of their funds, the individuals

of the richest decile lose 16.4 per cent.[21] This implies a disadvantage for poorer affiliates, who in all likelihood will face greater difficulties in building enough resources to obtain economic security in old age. The reasons for these results are related to the fact that the policies include maximum limits for the withdrawals, so that the withdrawn funds tend to represent lower shares of the pension pots of richer individuals and larger shares for poorer individuals. In addition, it is likely that poorer affiliates were eager to cash out more frequently and at the maximum possible amounts from their available funds because they are more liquidity constrained than richer affiliates.

The third panel of Figure 3 shows a socio-economic gradient in the loss of expected pension funds across the initial distribution of pension funds. The poorest decile of the distribution of pension funds experiences an average loss of about 60.3 per cent, while the richest decile experiences a loss of about 15.5 per cent. In between, there are not many differences in the losses of those individuals distributed between the third and eighth deciles, the average loss for them being about 43.6 per cent. Therefore, using either the distribution of pension savings or wages, the impact of the withdrawal policies is stronger among the poorest groups.

The frequency of contributions made by the individual (captured by the individual contribution density indicator) is also a key factor in determining the final value of the pension balance. There are sharp differences in this indicator among the affiliates, also implying a socio-economic gradient. Individuals with more stable jobs and higher wages tend to have higher levels of contribution density. On the contrary, individuals with various and longer spells of unemployment and/or transiting more frequently between the formal and informal economy are more likely to show low levels of contribution density. The fourth panel of Figure 3 shows the losses of expected pension savings according to the distribution of individual contribution densities. The individuals in the first and second deciles of contribution densities will suffer a loss in pension funds of about 88 per cent and 80 per cent, respectively. The reason is that the affiliates with low contribution density will not be able to rebuild their pension savings over their labour force lifespan, and therefore the withdrawals will have a sharper impact on their future pension savings. This situation is markedly different from that of individuals who contribute regularly. We observe that individuals in the highest decile of contribution density will lose about 14 per cent of their pension funds, which is much lower than the losses of the individuals in the first three deciles.

21. The two first percentiles are merged as there is a large number of individuals earning the minimum wage at the bottom of the wage distribution.

A potential unintended effect of the early withdrawals could be that the SNP affiliates may shift to the SPP in order to benefit from the withdrawal policies. However, note that this change does not entail monetary recognition for the contributions made to the SNP, and hence the individual shifting to the SPP will lose all previous contributions and would start with a pension balance equal to zero. Thus, the incentive to transit to the SPP is low.

Finally, in the online Appendix,[22] we provide several figures illustrating how the pension fund losses would change if different return rates were assumed (see Figures A.3 to A.10). As expected, a higher return rate increases the losses in the pension fund, both overall and for all the different groups considered. For example, for the poorest decile of the income distribution (see Figure A.8), the losses in pension wealth would be 45.2 per cent and 49.4 per cent if the assumed rates of return were 3.0 per cent and 7.5 per cent, respectively. For the richest income decile, these results would be 15.5 per cent and 18.2 per cent, respectively.

Conclusions

Most existing evidence on the impact of early pension withdrawals focuses on Chile and, to a lesser extent, Australia. This study adds to the literature by examining the case of Peru, where withdrawals have been exceptionally large, amounting to more than 10 per cent of GDP. In a politically driven dynamic between the Government and Congress, seven early withdrawal schemes were implemented and extended well beyond the end of the COVID-19 pandemic and its immediate economic effects. Unlike Chile and Australia, Peru lacks extensive social pensions and public safety nets for retirees, which could help ensure economic security in old age. This institutional gap makes the prospects for future pensioners particularly uncertain and sets Peru apart from countries with more developed and generous social protection systems for the elderly.

Although the main rationale for the withdrawal policies was to provide liquidity to families in need due to job losses and the economic crisis caused by the pandemic, in practice the policies were not targeted at this population. Eligibility requirements were very loose, so that virtually all affiliates could withdraw their pension funds, regardless of the size of their pension balances and income levels. As the last policies were implemented in periods beyond the immediate economic impact of the pandemic, one might think of "populist" reasons for politicians to enact these policies. This study has shown that these policies have become problematic. Pension funds have been severely reduced or even depleted, particularly for those affiliates with small pension balances.

22. See footnote 15.

Using simulations based on individual administrative micro-data, we find that, on average, individuals experience an expected decline of about 40 per cent in their accumulated pension funds at retirement age, but that there are important heterogeneous effects. Among these effects, we find a socio-economic gradient in the distribution of pension fund losses. Losses are larger for members at the bottom of the income or pension wealth distribution. Moreover, older people experience larger losses than younger people, as they have less time to rebuild their pension pots.

The withdrawal policy jeopardizes income security in old age, leaving SPP members with reduced or no pension savings to provide an income in later life. This is a clear example of how pension policy needs to be designed with sound technical expertise and less influenced by short-term political gains. Restoring pension wealth will be very difficult. Some studies in other countries have already suggested that policies such as increasing the retirement age, raising contribution rates and/or increasing public spending on social pensions will be unavoidable measures to restore economic security in old age.

It is important to note that a significant share of Peru's workforce is employed in the informal economy and therefore lacks pension coverage. While our analysis focuses on formal workers, early withdrawal policies may also have indirect effects on informality and contribution behaviour. Affiliates with low pension balances may find stronger incentives to exit the private pension system altogether and rely instead on social pensions. This dynamic could increase future pressure on already limited public safety nets and lead to an underestimation of the broader societal impact of these withdrawal measures.

While a major pension reform prohibiting early withdrawals was approved by the Peruvian Parliament in 2024, the measure was narrowly passed, with only 38 of 130 members voting in favour. Its approval has been widely contested due to divergent legal interpretations put forward by the politicians backing the reform. Consequently, the reform's credibility remains low, contributing to the slow and limited development of the secondary regulations necessary for its full implementation. Furthermore, it did not fully eliminate the possibility of withdrawing up to 95.5 per cent of pension funds at retirement, as this provision still applies to individuals aged 40 or older at the time of the reform. Ongoing efforts by parliamentarians to introduce new withdrawal initiatives underscore the persistent political momentum behind such measures. These developments highlight the considerable difficulty of reversing or preventing early-access policies in pension systems based on individual accounts.

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Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Income inequalities in longevity among Spanish retirement pensioners aged 65+: A comprehensive analysis from 2008 to 2021

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Abstract This paper examines disparities in longevity among Spanish retirement pensioners aged 65+, focusing on pension income and gender between 2008 and 2021. Using linked administrative records, we estimate life expectancy and complementary indicators (median, modal age at death, interquartile range). Results show persistent income-related gaps, especially for men, who face both shorter and less predictable lives, while female inequalities are smaller and tend to converge. Compared internationally, Spain displays

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distinctive narrowings for women but a widen-then-narrow pattern for men. Beyond documenting disparities, the article highlights how each longevity indicator offers distinct policy uses – for actuarial fairness, pension liabilities, and health and elderly care aimed at enhancing the well-being of disadvantaged groups.

Keywords actuarial, gender, life expectancy, pension scheme, pay as you go system, Spain

Introduction

Life expectancy is the most common metric of survival. It is the hypothetical average age at death given age-specific death rates in a given year. We are interested in examining the inequalities in life expectancy (LE) of retirement pensioners in Spain at ages 65 (LE_{65}) by pension income (PI) level.

The gender gap in pensions is more pronounced than the gender gap in wages in most countries within the European Union (Domínguez-Fabián et al., 2022). Both gaps have been extensively studied, yet there is a paucity of research focusing on income inequality in connection with old-age life expectancy, yet there is evidence that high-income countries experience substantial and potentially increasing inequality in late-life longevity (Fors, Wastesson and Morin, 2021). Studies using the amount of pension and/or pensionable earnings as a proxy for life expectancy are even scarcer, although some have been conducted in recent years for countries including Germany (Lampert, Hoebel and Kroll, 2019; Wenau, Grigoriev and Shkolnikov, 2019; Tetzlaff et al., 2020), the United States of America (Waldron, 2007; Goldman and Orszag, 2014; Bosley, Morris and Glenn, 2018, Italy (Ardito et al., 2022), Canada (Adam, 2012; Wen, Kleinow and Cairns, 2020; OSFIC, 2022), Chile (Edwards, Soto and Zurita, 2023), and Argentina (Bramajo and Grushka, 2019). For Spain, only two studies using the Continuous Sample of Working Lives (MCVL, also referred to as MCVL) have estimated life expectancy by pension amount (PI) – both restrict the analysis to male pensioners (Pérez-Salamero González, Regúlez-Castillo and Vidal-Meliá, 2021; Pérez-Salamero González et al., 2022).

This article focuses on Spain, a country for which little information about pensioners' life expectancy by PI level was known until recently. To the best of our knowledge, only two studies have examined this issue, and only for male pensioners (Pérez-Salamero González, Regúlez-Castillo and Vidal-Meliá, 2021;

Pérez-Salamero González et al., 2022). These authors found that individuals' PI levels contained information about their mortality experience and that this variable could be used as a proxy for socioeconomic status. They also found that disparities in LE_{65} and LE_{75} between pensioners in the lowest and highest income groups were relatively small and this gap in LE_{65} widened over time, from 1.49 years (2005–2009) to 2.54 years (2015–2018). These differences were statistically significant. The conclusions found by Pérez-Salamero González, Regúlez-Castillo and Vidal-Meliá (2021) and Pérez-Salamero González et al. (2022) were in line with previous findings for Spain involving older adults and using very different methodologies and/or databases (Regidor et al., 2012; Kulhánová et al., 2014; Permanyer et al., 2018; González and Rodríguez-González, 2021).

While the significance of the findings for the Spanish case is acknowledged, the two papers have a notable limitation in that they did not examine the case of females. They argued that this was because of lower labour force participation rates for female cohorts in Spain and the fact that women sometimes have shorter careers (in terms of years of employment) and may work less intensively than men due to family roles and commitments.

Another limitation of both papers is that longevity was measured solely in terms of life expectancy, without examining other indicators. To provide a more comprehensive analysis, it is important to complement life expectancy with additional metrics: the median can highlight robust central tendencies, the modal age at death captures shifts at older ages, and the interquartile range reveals lifespan variation and survival predictability (Canudas-Romo, 2008; Horiuchi et al., 2013; Aburto and van Raalte, 2018; Vidal-Meliá, Ventura-Marco and Garvey, 2024). Incorporating these measures allows a more nuanced understanding of longevity inequalities across pension-income and gender groups.

This article examines the disparities in longevity between males and females, focusing on key statistical measures such as life expectancy, mode, interquartile range (IQR), and median by pension income. To do this we use a large administrative data set (MCVL, the Continuous Work History Sample – *la Muestra Continua de Vidas Laborales* in Spanish) to estimate inequalities in longevity among male and female pensioners grouped according to their PI levels.[1] We study mortality trends among retirement pensioners aged 65 or older for the period 2008–2021.

The PI-longevity gradient is quantified in two ways. The first is by estimating the changes in total life expectancy by PI level at age 65 (LE_{65}) over time. The second is by introducing some additional longevity and life span variation indicators by PI level at age 65, these being the median age at death, the interquartile range and the modal age at death (Wilmoth and Horiuchi, 1999; Cheung et al., 2005). As a

1. Access the web portal of the Continuous Work History Sample.

supplementary approach, we also provide a comparison with the LE_{65} for the Spanish population as a whole.

This study is structured around several key research questions:

First, do differences in longevity exist between pension income (PI) groups for male and female pensioners, and if so, are these differences statistically significant? Second, do trends in life expectancy vary between PI groups, leading to a widening or narrowing of inequalities over time? Third, is the evolution of longevity by PI group consistent across genders? Fourth, are additional longevity indicators (median, modal age at death, interquartile range) aligned with, or do they reveal different patterns from, life expectancy within PI groups? Fifth, how has the longevity of the general population and the various PI-classified pensioner groups evolved over time? Finally, what distinct insights and policy applications can each indicator provide for understanding and addressing longevity disparities?

The remainder of the article is structured as follows: first, the data and methodology are described, together with the definition of variables and the classification of socioeconomic groups. The next section presents the empirical results, including complementary longevity indicators, comparisons with the general population, and the impact of the COVID-19 pandemic. This is followed by a comprehensive discussion that integrates the main findings, international contextualization, policy implications, and limitations. The article concludes with a summary of the key contributions.[2]

Data and methodology

This study utilizes the Continuous Work History Sample (MCVL), a comprehensive Spanish administrative dataset that offers several advantages over traditional survey data, including larger sample sizes, reduced costs, and decreased respondent burden. The MCVL dataset has been published annually since 2004, each edition containing social security records for a 4 per cent non-stratified random sample of individuals who, during that year, had any interaction with Spain's social security system. This includes those who were employed, receiving unemployment benefits, or drawing a pension. Individuals without any connection to the social security system in a given year are not included, and civil servants are similarly excluded from the dataset (Pérez-Salamero et al., 2021).

The MCVL compiles administrative data on individuals' working lives, drawing from anonymized microdata derived from social security records, which provide

2. This article is supplemented by an online Appendix, developed by the authors and made available to readers. See Supporting information for additional methodological details and supplementary analyses.

detailed personal information (Pérez-Salamero González, Regúlez-Castillo and Vidal-Meliá, 2017). The initial wave of the MCVL encompasses individuals who had any form of financial relationship with the social security system in 2004, including their entire working history. The sample is subsequently updated annually with data reflecting the variables tracked by the social security system since the start of computerized record-keeping, supplemented by information from other administrative sources that capture additional individual data. As of the time of this study, the available data spans from 2004 to 2021.

Our study focuses on a cohort comprising true retirement pensioners who retired at or after the statutory retirement age of 65, and who were classified under the general scheme, the primary segment of the Spanish social insurance system. Notably, until 31 December 2012, the statutory retirement age in Spain was age 65. However, a gradual transition is taking place between 2013 and 2027, culminating in two standard retirement ages from 2027 onwards: age 65 for individuals with at least 38.5 years of contributions and age 67 for those with a minimum of 37 years of contributions.

The Spanish public pension system is a mandatory, contributory, defined benefit scheme financed on a pay-as-you-go (PAYG) basis. Benefits are linked to contribution histories and statutory rules, with the statutory retirement age being gradually raised from age 65 to age 67 between 2013 and 2027. Although special regimes exist (self-employed workers under the *Regimen Éspecial de Trabajadores Autónomos* (*RETA*), civil servants under the *Régimen de Clases Pasivas*), over 90 per cent of pensioners belong to Spain's general scheme. What makes the Spanish case distinctive among Member countries of the Organisation for Economic Co-operation and Development (OECD) is that the public first pillar is virtually the only source of retirement income; occupational and private pensions cover only a small minority of the elderly. According to European Union (EU) microdata from the EU statistics on income and living conditions (EUSILC) and household budget survey data, more than 90 per cent of retired households' disposable income derives from these public pensions, with very limited weight from other sources.[3] These features make Spain's system one of the most public-centred and redistributive within the OECD, with relatively high replacement rates but limited diversification into other retirement income pillars (OECD, 2023). In this context, pension income provides a direct and robust measure of retirees' economic position.

Consistent with prior research that employed the MCVL to examine mortality and longevity among pensioners categorized by PI level Pérez-Salamero González, Regúlez-Castillo and Vidal-Meliá, (2021) and Pérez-Salamero González et al. (2022), we exclude from our analysis retirement pensioners covered under

3. See the Eurostat EUSILC web portal.

the special system for self-employed workers (RETA), individuals whose disability benefits were reclassified as retirement benefits, and early retirees who accessed benefits before reaching the statutory retirement age.

Coverage of our study population is approximately 91.7 per cent of Spanish retirement pensioners aged 65+ in 2008–2021. This share results from excluding civil-service (*Régimen de Clases Pasivas*) and non-contributory pensions from official beneficiary stocks. We do not impose a minimum contributory-history threshold; coverage refers to observed 65+ beneficiaries in the MCVL.

Variables and socioeconomic groups

We have divided the pensioners into specific income quartiles, in this case four equal-sized segments that each contain approximately a quarter (25 per cent) of the individuals. These segments are denoted G_1 – the PI group for pensioners with the lowest 25 per cent of retirement benefits ("lowest"); G_2 – for pensioners with retirement benefits between 26 per cent and 50 per cent (up to median, "second"); G_3 – in which the benefit amount is between 51 per cent to 75 per cent (above the median, "third"); and G_4 – which covers those pensioners with the highest 25 per cent of retirement benefits ("highest"). The people within each group do not represent exactly 25 per cent, since the number of deaths within each group varies over the six years of each window. The individuals (alive or deceased) assigned to each group according to their PI level represent exactly 25 per cent of the sample. Quartiles were calculated separately by sex and by rolling window.

We are mainly interested in the first (lowest) and fourth (highest) groups.

Focusing on the first (lowest) and fourth (highest) pension income (PI) groups is essential because these groups represent the most economically disadvantaged and advantaged segments of the population, respectively. Analysing these extremes captures the full range of socioeconomic disparities in longevity, providing clear insights into the extent of inequality. Differences in life expectancy and other longevity indicators are typically most pronounced between these two groups, making it easier to identify and quantify the impact of socioeconomic status on longevity.

Additionally, understanding the disparities between the lowest and highest PI groups is crucial for informing policy interventions aimed at reducing inequality and improving public health outcomes. These groups often represent the target populations for such policies. By focusing on these extremes, the study also facilitates comparison with other research and international contexts, allowing for broader generalizations about inequality trends.

Table 1. *Pensioners by PI level: exposures (Exp) in person-years, number of deaths (De) and crude death rates (%) for selected periods (W_1 2008–2013, W_5 2012–2017 and W_9 2016–2021)*

Periods	Items	Pension income quartile (females)				Pension income quartile (males)			
		G_1	G_2+G_3	G_4	Total	G_1	G_2+G_3	G_4	Total
W_1	Exp	25,758	48,971	26,009	100,737	31,763	75,601	35,850	143,213
	%	25.57	48.61	25.82	100	22.18	52.79	25.03	100
	De	1,144	1,000	522	2,666	1,692	2,611	699	5,002
	%	4.44	2.04	2.01	2.65	5.33	3.45	1.95	3.49
W_5	Exp	36,620	72,485	34,419	143,523	44,287	92,771	46,590	183,648
	%	25.52	50.50	23.98	100	24.12	50.52	25.37	100
	De	1,788	1,345	555	3,688	2,382	2,993	830	6,205
	%	4.88	1.86	1.61	2.57	5.38	3.23	1.78	3.38
W_9	Exp	41,006	85,660	41,212	167,877	43,765	100,655	51,823	196,242
	%	24.43	51.03	24.55	100	22.30	51.29	26.41	100
	De	2,148	1,519	599	4,266	2,328	3,684	1,064	7,076
	%	5.24	1.77	1.45	2.54	5.32	3.66	2.05	3.60

Note: Percentages of exposures refer to the share of each group in total exposures and therefore sum to 100%. Percentages of deaths are recalculated as deaths divided by exposures within each group (crude mortality rates), including the corresponding overall rate in the "Total" column. These do not sum to 100% across groups.
Source: Own work based on DGOSS (2008–2021).

Table 1 shows the exposures in person-years and number of deaths (percentages) for three of the periods studied (three of the nine rolling windows).

The percentages of deaths presented in Table 1 represent crude mortality rates (deaths over exposures) within each group and are therefore not additive to 100 per cent. This provides a clearer picture of the mortality risk of each pension income quartile and the total population.

Between the first rolling window and the last, the number of exposures in person-years increases by almost 50 per cent (from 243,950 to 364,119), with a 66 per cent increase for women and a 37 per cent increase for men. The share of women in the total number of exposed pensioners increases from 41.23 per cent to 46.10 per cent.

Methodology

The PI-longevity gradient is quantified in two ways. The first is by considering changes in total life expectancy by PI level at age 65 (LE_{65}) over time. We use the

Mort1Dsmooth function in the MortalitySmooth R package (Camarda, 2012) – which is tailored to smooth mortality rates across different ages with P-splines – to construct complete-period life tables from age 65 to age 105 and to calculate LE_{65} for each rolling window of six years. Data for ages above age 105 are unreliable because the exposures are small and, in addition, the reporting of deaths is questionable for very old ages.

A second method for quantifying the relationship between pension income (PI) and longevity involves estimating additional indicators of longevity and life span variation by PI level at age 65. While the mean age at death, or life expectancy, is commonly used as the preferred measure of longevity, other central tendency measures, such as the median and modal ages at death, also provide valuable insights into the distribution of deaths (Canudas-Romo, 2010). These measures complement one another by offering a more comprehensive understanding of the central tendencies in mortality (Vidal-Meliá, Ventura-Marco and Garvey, 2024).

The median age at death (Md) is defined as the age by which half of a hypothetical cohort has died. In our analysis, this cohort comprises individuals aged 65 or older. The adult modal age at death (M) is the age beyond infancy at which the highest number of deaths occur. This measure is frequently used to examine mortality differences at older ages and serves as a natural metric for assessing life span and its variation (Kannisto, 2001). Under a given mortality regime, M reflects the most common or "typical" life span among adults (Diaconu, van Raalte and Martikainen, 2022). Unlike conventional measures of old-age mortality, such as life expectancy, M has the advantage of not being influenced by an arbitrarily chosen threshold for "old" age and is determined solely by mortality at older ages. Despite its intuitive significance and beneficial properties, M has not been widely utilized to explore socioeconomic disparities in mortality.

Various measures are available for assessing life span variation, each with distinct properties (van Raalte and Caswell, 2013). These measures collectively aim to quantify the degree of heterogeneity in the ages at death within a population (Hiam, Minton and McKee, 2021; Seaman et al., 2019). The interquartile range (IQR), also known as the middle 50 per cent (Wilmoth and Horiuchi, 1999), represents the distance between the lower and upper quartiles of the age distribution of deaths in a life table. A decrease in IQR indicates a reduction in the variability of ages at death, making it an appealing single measure of variability due to its straightforward calculation and interpretation as the range encompassing the middle 50 per cent of deaths.

Indicators of life span variation have significant implications on both individual (micro) and population (macro) levels (van Raalte et al., 2018). At the micro level, life span variation highlights individual uncertainty concerning the timing of death. From this perspective, increasing life span variation among different PI groups suggests a growing dimension of social inequality in longevity. Specifically,

pensioners from higher PI levels can plan their remaining years more effectively, while those from less advantaged groups face greater uncertainty about their survival. At the macro level, life span variation serves as an indicator of

Table 2. *LE_{65}. 95% confidence intervals by PI group*

Females		G_1			Whole			G_4	
Periods	**2.5th**	**50th**	**97.5th**	**2.5th**	**50th**	**97.5th**	**2.5th**	**50th**	**97.5th**
2008-2013 (W_1)	23.13	**23.67**	24.20	24.94	**25.20**	25.46	24.98	**25.59**	26.19
2009-2014 (W_2)	22.74	**23.29**	23.85	25.15	**25.40**	25.64	25.08	**25.65**	26.21
2010-2015 (W_3)	22.98	**23.58**	24.18	25.24	**25.47**	25.71	25.12	**25.66**	26.20
2011-2016 (W_4)	23.43	**24.02**	24.61	25.41	**25.64**	25.87	25.48	**26.02**	26.56
2012-2017 (W_5)	23.35	**23.94**	24.52	25.52	**25.74**	25.95	25.60	**26.13**	26.66
2013-2018 (W_6)	23.84	**24.37**	24.89	25.66	**25.87**	26.08	25.77	**26.32**	26.86
2014-2019 (W_7)	24.24	**24.77**	25.29	25.82	**26.03**	26.24	26.07	**26.60**	27.13
2015-2020 (W_8)	23.87	**24.37**	24.87	25.63	**25.84**	26.04	26.45	**27.03**	27.61
2016-2021 (W_9)	23.94	**24.36**	24.78	25.70	**25.91**	26.11	26.46	**27.03**	27.61
Males		G_1			Whole			G_4	
Periods	**2.5th**	**50th**	**97.5th**	**2.5th**	**50th**	**97.5th**	**2.5th**	**50th**	**97.5th**
W_1	19.75	**20.19**	20.64	21.50	**21.71**	21.92	22.20	**22.86**	23.53
W_2	19.65	**20.08**	20.50	21.68	**21.89**	22.09	22.74	**23.47**	24.20
W_3	19.26	**19.67**	20.09	21.63	**21.82**	22.02	22.49	**23.09**	23.70
W_4	19.11	**19.49**	19.88	21.70	**21.90**	22.09	22.92	**23.56**	24.19
W_5	19.35	**19.75**	20.15	21.92	**22.11**	22.30	22.99	**23.54**	24.10
W_6	19.33	**19.73**	20.14	21.95	**22.14**	22.32	23.21	**23.74**	24.28
W_7	19.45	**19.86**	20.28	21.92	**22.11**	22.30	22.98	**23.48**	23.97
W_8	19.65	**20.07**	20.49	21.79	**21.97**	22.16	22.73	**23.17**	23.62
W_9	19.83	**20.25**	20.66	21.71	**21.89**	22.08	22.65	**23.08**	23.51

Note: Minimum values are indicated by a circle, and maximum values are indicated by a box.
Source: Own work based on DGOSS (2008–2021).

heterogeneity in population longevity. Within this study's context, a rise in life span variation among disadvantaged groups indicates that these pensioners are experiencing increasingly diverse life courses.

Results

Life expectancy at age 65 (LE_{65}) by pension income (PI) level and gender

The analysis confirms a positive relationship between life expectancy at age 65 (LE_{65}) and pension income (PI) levels for both genders across all periods studied (Table 2). Female pensioners consistently show higher LE_{65} than their male counterparts across all PI levels. However, the evolution of LE_{65} differs significantly between genders.

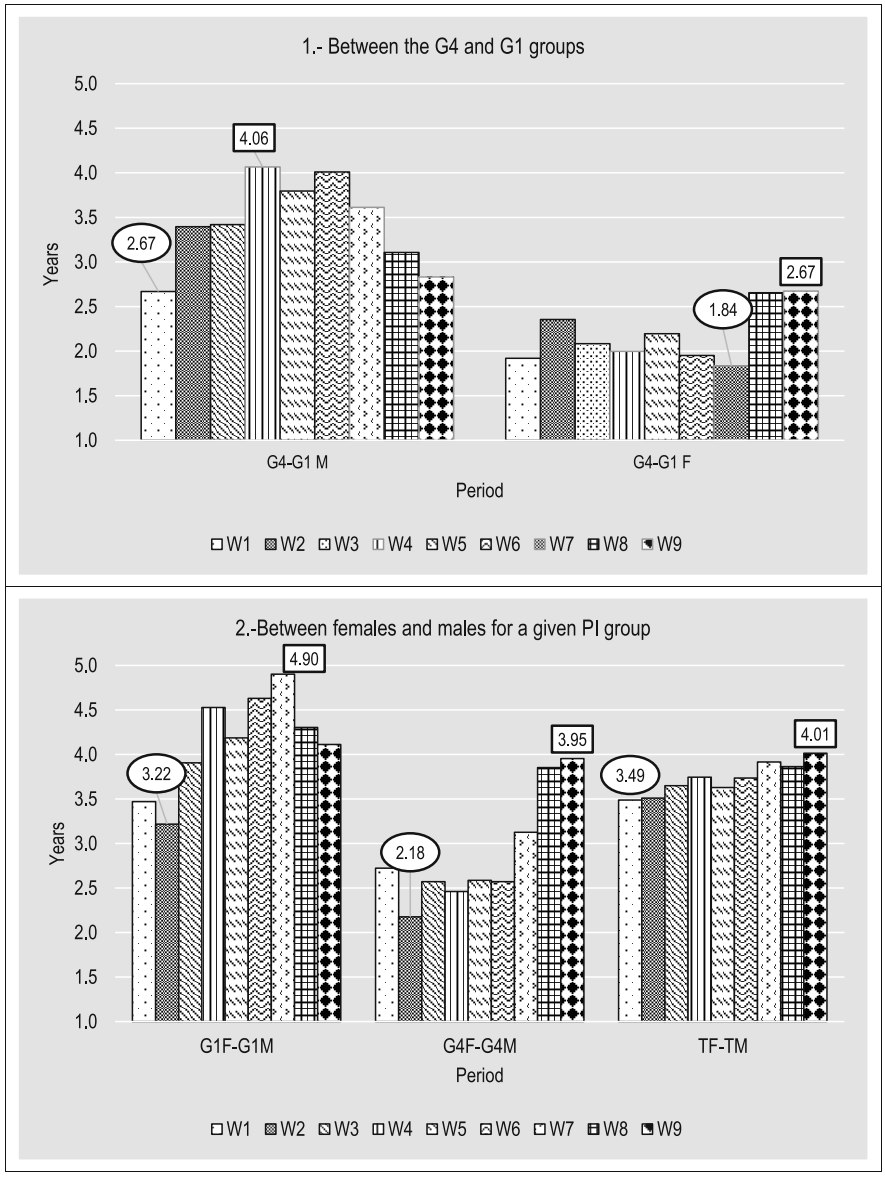
For males, the LE_{65} of the highest PI group (G_4) peaked during 2014–2018 (23.74 years) before declining to 23.08 years in 2016–2021. In contrast, the lowest PI group (G_1) saw an increase from 19.49 years in 2011–2016 to 20.25 years in 2016–2021, reducing the gap between these groups. For females, the G_1 group reached its highest LE_{65} in 2014–2019 (24.77 years) but dropped to 24.36 years in the following period, likely due to the COVID-19 pandemic, while the G_4 group's LE_{65} continued to rise, reaching 27.03 years by the final period.

These patterns suggest that the COVID-19 pandemic disproportionately affected certain groups. In particular, the G_1 female group experienced a decline in LE_{65} in the last period, while the G_4 female group showed a more modest impact, and the G_1 male group even saw a temporary increase. Overall, the trajectory of LE_{65} for all female pensioners broadly reflects the evolution of the G_1 group, whereas for males it aligns more closely with the G_4 group.

In the tables and figures, the minimum values are indicated by a circle and the maximum values by a box. It is important to note that the maximum and minimum values differ between the two groups of pensioners analysed.

These trends are further illustrated in Figure 1, which shows the absolute differences in LE_{65} between G_4 and G_1 groups. For males, the gap widened initially but then narrowed, while for females, the differences were smaller and more stable over time. The gender differences in LE_{65} also reveal that females in the most disadvantaged group (G_1) consistently outlive their male counterparts, with the absolute difference between genders within the same PI group increasing over time, particularly in G_1.

Figure 1. *Absolute differences in LE_{65} (PI groups and sexes)*



Source: Authors' elaboration.

Additional longevity indicators: Median age at death (Md_{65}), modal age at death (M_{65}) and interquartile range (IQR_{65})

In addition to LE_{65}, the study examines other indicators, including the median age at death (Md_{65}), modal age at death (M_{65}), and interquartile range (IQR_{65}).[4]

Median age at death (Md_{65}). The Md_{65} values are generally higher in the G_4 group than in the G_1 group for both genders, indicating longer lifespans among those with higher pension incomes. For females, the gap between G_1 and G_4 in Md_{65} has slightly narrowed over time, while for males, the gap has remained relatively stable, with G_4 consistently showing higher values.[5]

Modal age at death (M_{65}). The M_{65}, representing the most common age at death, follows a pattern similar to Md_{65}. For females, the M_{65} in the G_4 group is higher and more stable, while the G_1 group shows more variability. The proportion of pensioners surviving to M_{65} remains relatively constant over time for both G_1 and G_4 groups, with a slight decline observed during the COVID-19 pandemic-affected periods. For males, the G_4 group exhibits a higher and more stable M_{65} compared to the G_1 group, which shows more fluctuation and generally lower M_{65} values.[6]

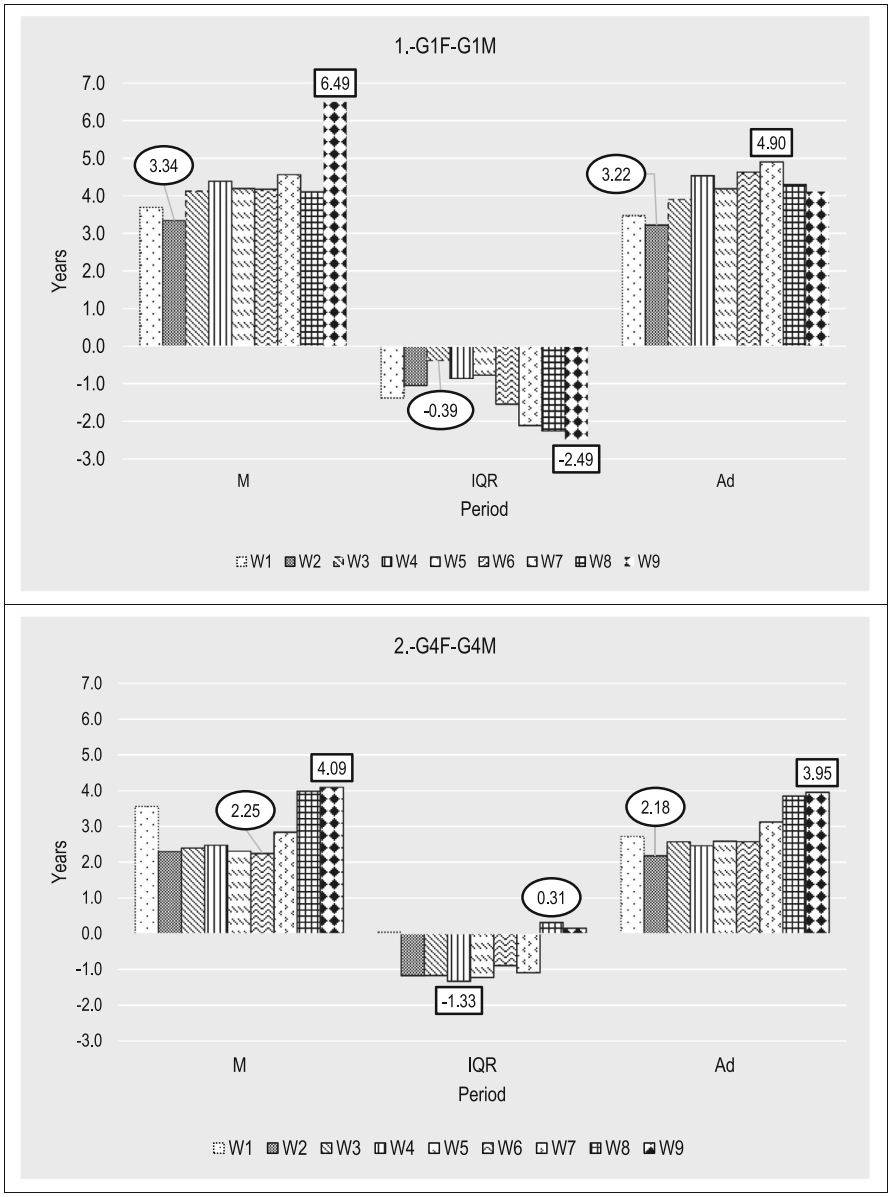
Interquartile range (IQR_{65}). The IQR_{65}, a measure of variability in age at death, shows divergent trends by gender.[7] For females, IQR_{65} values between the G_1 and G_4 groups have converged over time, indicating decreasing variability in lifespan. In contrast, for males, the IQR_{65} has diverged, with G_1 showing increasing variability compared to the more stable G_4 group. This suggests that socioeconomic inequality in longevity, as measured by lifespan variability, is more pronounced among disadvantaged males.

Absolute differences between G_4 and G_1 groups

The absolute differences in longevity indicators between the G_4 and G_1 groups offer deeper insights into the extent of socioeconomic inequality (Figure 2). For both males and females, the absolute differences in LE_{65}, Md_{65}, and M_{65} are consistently larger for males, indicating greater disparities in longevity among men. However, the absolute differences in IQR_{65} differ by gender, with females

4. See Supporting information, Tables OA.1 and OA.2 in the online Appendix A.2.
5. See Supporting information, Table OA.1 in the online Appendix A.2.
6. See Supporting information, Table OA.2 in the online Appendix A.2.
7. See Supporting information, Tables OA.1 and OA.2 in the online Appendix A.2.

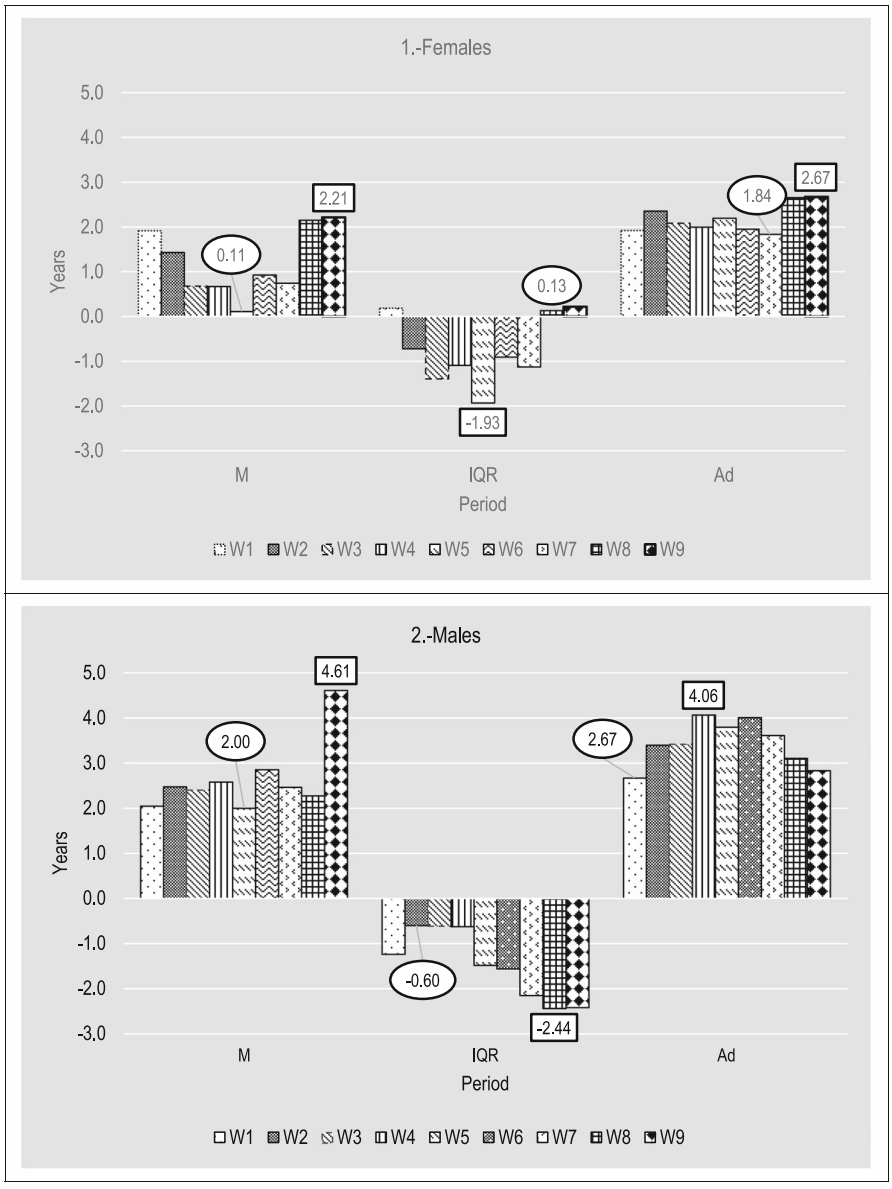
Figure 2. *Absolute differences between females and males for a given PI group in IQR_{65}, Md_{65} and Ad_{65}*



Source: Authors' elaboration.

showing a convergence between the G_1 and G_4 groups over time, while males exhibit increasing divergence.

Figure 3. *Absolute differences between the G_4 and G_1 groups in IQR_{65}, Md_{65} and Ad_{65}*



Source: Authors' elaboration.

The absolute differences in LE_{65} between the G_4 and G_1 groups fluctuate over time, with males showing the largest disparities in earlier periods (Figure 3). For females, these differences are smaller but increase slightly during the

pandemic-affected periods. The patterns in Md_{65} and M_{65} largely mirror those of LE_{65}, with males consistently showing greater disparities. In contrast, the differences in IQR_{65} demonstrate a divergent trend for males and a convergent trend for females, highlighting different patterns of lifespan variability by gender.

In sum, the complementary measures nuance the evidence from LE_{65}. Md_{65} indicates a slight narrowing of female income inequalities but persistent male disparities. M_{65} shows that higher-income groups not only achieve higher ages but also concentrate around a common lifespan. IQR_{65} uncovers a double disadvantage for low-income males, who experience both shorter and more uncertain lives, whereas among females variability converges, indicating more predictable survival prospects.

Read together, the indicators answer complementary questions at age 65: LE_{65} shows the average remaining years, Md_{65} corroborates the central tendency, M_{65} locates the typical late-life age at death (driven by old-age mortality), and IQR_{65} captures lifespan variation (uncertainty). In Spain, females display small and converging IQR_{65} across PI groups, whereas low-PI males combine lower LE_{65} with a wider IQR_{65}; M_{65} is higher and more clustered in G_4, indicating compression at later ages (Canudas-Romo, 2008; Horiuchi et al., 2013; Aburto and van Raalte, 2018; Su et al., 2024).

Longevity comparisons with the general population

Comparing the LE65 of pensioners with that of the general population reveals that pensioners generally have a longevity advantage, likely reflecting the eligibility for and receipt of social security old-age pensions (Figure 4). For both genders, the absolute differences in LE_{65} between pensioners and the general population ($ADLE_{65}$) are positive across all PI groups and periods. However, the trends differ by gender and PI level.

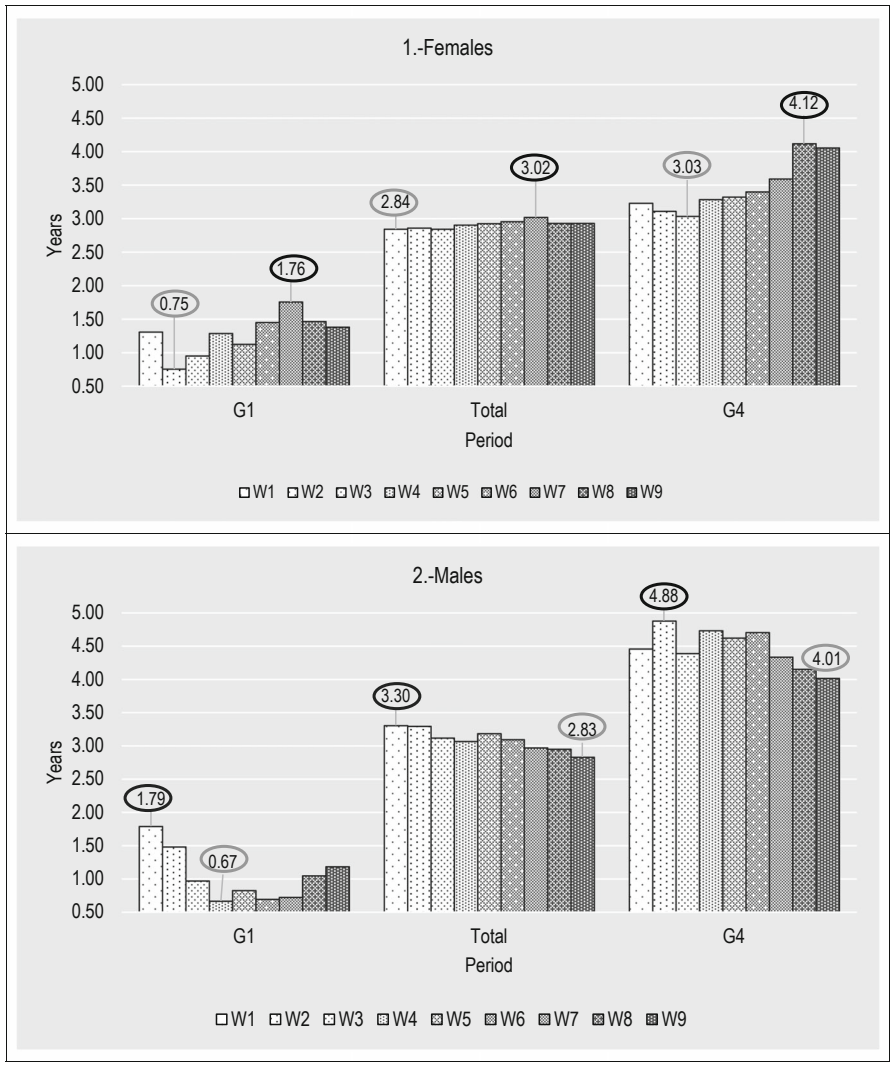
For females, the $ADLE_{65}$ shows a slight upward trend over time, particularly for the G_4 group, indicating increasing longevity advantages for higher-income pensioners. Conversely, for males, $ADLE_{65}$ exhibits a downward trend, particularly for the G_1 group, suggesting a relative decline in longevity compared to the general population. The convergence of $ADLE_{65}$ for G_4 males and females in the final period underscores the widening longevity gap between the most advantaged pensioners and the general population.

Impact of the COVID-19 pandemic

The COVID-19 pandemic had a significant impact on longevity indicators, particularly for the most disadvantaged groups. For females, the pandemic led to a decline in LE_{65} and an increase in IQR_{65} in the G_1 group, reflecting both reduced life expectancy and increased variability in age at death.[8] For males, the

8. See Supporting information, Tables OA.1 and OA.2 in the online Appendix A.2.

Figure 4. *$ADLE_{65}$. pensioners versus general population*



Source: Authors' elaboration.

pandemic exacerbated existing disparities, with the G_1 group experiencing a sharper decline in LE_{65} and a widening IQR_{65}.

Despite these pandemic-related impacts, the overall trend of increasing longevity inequality persists, particularly among males in the G_1 group. This highlights the vulnerability of disadvantaged pensioners to external shocks and underscores the need for targeted interventions to mitigate these effects.

It is also worth noting that annual changes in LE_{65} can partly reflect random fluctuations, particularly in smaller groups, which may explain apparent anomalies such as the temporary "benefit" observed for the least advantaged males and most advantaged females during the pandemic. Promising statistical methods to address this issue have been proposed recently (e.g. Navarro and Requena, 2023), but their application lies beyond the scope of this article.

Discussion

The discussion is organized into four parts. It first synthesizes the main findings of the study. The next subsection places the Spanish evidence in an international perspective. Building on this, we examine the policy implications for pension design, actuarial practice, and public health. Finally, the discussion addresses the study's limitations, providing a balanced interpretation of the results.

Findings

The data reveals several key differences in life expectancy, mode, IQR, and median age at death between males and females by pension income. These differences stress the complex interplay between gender, pension income level, and longevity.

- Life expectancy: Females consistently have higher life expectancy than males across all pension income levels. The positive correlation between pension income and life expectancy is evident for both genders, but the impact is more pronounced for men.
- Mode: The mode of age at death is higher for females and increases with higher pension income for both genders. The impact of pension income on the mode is more significant for males, reflecting greater economic disparities in male longevity.
- IQR: Females have a narrower IQR, indicating more consistent life spans. Higher pension income levels are associated with a narrower IQR for both genders, but the effect is more pronounced for males due to their greater initial variability.
- Median: The median age at death is higher for females and increases with higher pension income for both genders. The differences in median age at death between income quartiles are more pronounced for males, indicating greater socioeconomic inequality.

These findings demonstrate that socioeconomic inequalities in longevity cannot be fully understood through LE_{65} alone. While life expectancy provides a robust summary, the additional indicators reveal further complexity in the mortality gradient: disadvantaged males face both shorter and more uncertain survival, undermining their ability to plan retirement and well-being, whereas female inequalities remain more stable. Taken together – and strictly within our sex-PI-age-65 framework – movements in LE_{65} and Md_{65} across PI groups indicate broad shifts rather than tail effects; a higher and tighter M_{65} in high-PI points to late-life survival gains and compression (Canudas-Romo, 2008; Horiuchi et al., 2013); and the wider IQR_{65}

among low-PI males reveals greater uncertainty in remaining lifespan, supporting targeted prevention/outreach and risk-aware retirement guidance (Aburto and van Raalte, 2018; Su et al., 2024). These implications complement the LE-based gradient and connect directly to pension adequacy and health policy.

International comparisons

One question that immediately comes to mind is: are our results in line with those obtained in other countries using pension amounts and/or pensionable income?

When situating the Spanish findings within an international perspective, some caution is required, since the definitions of "lowest" and "highest" pension income groups differ across countries and methodologies, and thus direct comparability is limited.[9] Nevertheless, the international evidence reveals clear patterns that allow Spain's position to be contextualized.[10]

In Germany, results are broadly similar to those observed in Spain, with persistent but relatively stable differentials (Lampert, Hoebel and Kroll, 2019; Tetzlaff et al., 2020). By contrast, Canada, the United States of America, and Sweden display a clear widening of longevity gaps, particularly in recent decades (Reznik et al., 2021; Fors, Wastesson and Morin, 2021; OSFIC, 2022). Italy has been portrayed in prior studies as showing strong and persistent socioeconomic inequalities (Ardito et al., 2022), although the absolute gaps are more modest, reflecting definitional and period differences.[11] In the Netherlands, socioeconomic gradients in mortality have remained enduring despite overall gains in longevity (Kalwij, Alessie and Knoef, 2013). Beyond Europe and North America, Latin American evidence consistently points to large disparities, with Chile and Argentina reporting high levels of inequality in late-life survival linked to pension income and educational stratification (Edwards, Soto and Zurita, 2023; Bramajo and Grushka, 2019). Taken together, these comparisons indicate that, while Spain shares with Germany a relative stability of gradients, other countries reveal widening or persistently intense gaps, underscoring the heterogeneous trajectories of longevity inequality across contexts.

Finally, our comparison also highlights a significant gap in existing research: most previous international studies focused solely on life expectancy, without considering complementary measures such as median age at death, modal age at death, or lifespan variation. By incorporating these additional indicators, our study provides a more nuanced understanding of inequalities in old-age longevity and contributes novel evidence to the comparative literature.

9. See Supporting information, online Appendix A.1 for details.
10. International evidence is compiled in Supporting information, online Appendix A.2, Tables OA.6–OA.9.
11. See Supporting information, online Appendix A.2 for details.

Policy uses by indicator

Life tables by pension income (PI) quartiles are not only useful for documenting inequalities in longevity, but they also provide practical tools that can strengthen actuarial analysis and policy design in the Spanish pension system. The four indicators at age 65 considered in this study – life expectancy (LE_{65}), the median age at death (Md_{65}), the modal age at death (M_{65}) and the interquartile range of age at death (IQR_{65}) – each add complementary information that can directly improve standard actuarial uses and official reporting.

Actuarial fairness and distributional assessment (money's worth and internal rate of return). The first application is the routine publication of money's-worth ratios and internal rates of return (IRR) for representative workers and pensioners, stratified by sex and PI quartile. In the United States of America, the Office of the Chief Actuary of the Social Security Administration regularly produces such analyses for hypothetical workers (Rose, Burkhalter and Nickerson, 2024), and IRR is standard in the PAYG distributional literature (Knell, 2010). For Spain, the Bank of Spain has estimated IRRs for new retirees in 2017 (Moraga and Ramos, 2020), but these rely on general-population mortality. Substituting PI-specific life tables would align evaluations with the actual survival patterns of contributors. LE_{65} provides the baseline valuation; M_{65} and Md_{65} add information on whether survival gains are concentrated at later ages; and IQR_{65} highlights inequality and uncertainty across groups (Rose, Burkhalter and Nickerson, 2024; Knell, 2010; Moraga and Ramos, 2020).

Calibrating annuity and benefit factors in notional defined contribution-type settings. Another application concerns the calibration of annuity divisors and benefit conversion factors in notional defined contribution-type settings. When average population life expectancy is used for all, high-PI groups (who live longer) receive overstated pensions, while low-PI groups (who live shorter lives) receive understated ones – an implicit redistribution (Alonso-García et al., 2019; Bravo et al., 2021). Using PI-specific LE_{65} reduces this transfer by anchoring benefits to the longevity of each subgroup. Md_{65} and M_{65} help ensure factors are not driven by tail effects, while IQR_{65} highlights the groups that face particular uncertainty and may require risk-aware options in benefit design (Alonso-García et al., 2019; Bravo et al., 2021; Canudas-Romo, 2008; Horiuchi et al., 2013).

Risk-aware retirement guidance and targeted prevention. The IQR_{65} is also important as an "uncertainty flag". It identifies groups with shorter and less predictable lifespan – most notably low-PI men. Since means and dispersion can move independently, higher variation itself deserves policy recognition. A wider

IQR_{65} supports targeted health strategies (primary care and prevention) and financial guidance that incorporates risk (buffer savings, survivor protection, longevity hedges). M_{65} complements these insights by pointing to whether survival gains and compression are concentrated at older ages in higher-PI groups, information that can influence communication strategies and default options (Aburto and van Raalte, 2018; Su et al., 2024).

Valuing accrued-to-date pension liabilities (ADL — ESA2010 "Table 29"). A further use is in the valuation of accrued-to-date pension entitlements required under the European System of Accounts (more commonly known as ESA2010). Spain currently values liabilities using general-population mortality from INE (2022) and Eurostat projections,[12] but pensioners exhibit systematically higher LE_{65} than the general population, so existing practice understates the liability. Using PI-specific mortality aligns valuations with the covered population. In addition, M_{65} and IQR_{65} are informative for sensitivity checks, clarifying whether liabilities are sensitive to shifts in typical late-life survival or to dispersion at the bottom of the distribution (ECB and Eurostat, 2020; Garvey, Castañer and Vidal-Meliá, 2023).

Transparency and monitoring of inequality. PI-specific mortality tables can also strengthen the transparency of actuarial communication. Publishing not only average survival (LE_{65}) but also indicators of inequality (such as IQR_{65}, already applied here) would make visible the heterogeneity of lifespan prospects across income groups. This information helps stakeholders understand that not all contributors face the same longevity, reinforcing the fairness dimension of pension debates. In addition, while our study focuses on four core indicators, the broader mortality literature suggests complementary measures – such as life disparity ($e^{\dagger}$), the age threshold separating early from late deaths ($\alpha^{\dagger}$), or the Gini of longevity – that could be explored in future work as additional tools for monitoring dispersion and inequality (Zafeiris, 2024). Together, these extensions would allow Spanish institutions to improve regular reporting, increase public trust, and monitor inequality trends in retirement outcomes more systematically.

In sum, each indicator connects naturally to specific policy uses: LE_{65} sets the baseline for valuation and annuity factors; Md_{65} provides a robust centre that avoids distortions from extreme values; M_{65} reveals late-life concentration of gains and compression; and IQR_{65} captures survival variation and double disadvantage among low-PI groups. Together, they provide a richer actuarial toolkit for evaluating fairness, calibrating benefits, targeting risk-aware guidance, and valuing pension liabilities.

12. See footnote 3.

Limitations

Several limitations should be considered when interpreting our findings. First, while pension income (PI) serves as a robust proxy for socioeconomic status, particularly for lower-income pensioners, we acknowledge it may not fully capture total income, especially for higher-income groups with additional investments or private pensions. It is worth noting, however, that for 70 per cent of Spanish pensioners the state pension is their only source of income (Pérez-Salamero González et al., 2022), which makes PI a good indicator for the majority, especially in the lowest quartile (G_1), even if less accurate for the highest (G_4).

Second, our analysis excludes certain groups of pensioners, such as those with disability pensions, early retirees, and those covered by special schemes (e.g. self-employed workers), for whom applying our longevity indicators may not have been appropriate.

Third, we were unable to include pensioners under the *Régimen de Clases Pasivas* (civil servants), since they are not recorded in the MCVL database.

Fourth, although the sample does not permit nationwide extrapolation to all pensioners, it does cover a substantial share of this population. In 2021 there were 4,448,130 pensioners in the general scheme, representing 91.72 per cent of total retirement pensioners excluding the self-employed (MITES, 2023).

Fifth, our classification of PI into quartiles might omit heterogeneity within groups. If full individual-level records from the Spanish social security system, including supplementary income data, were available, the use of quintiles or deciles instead of quartiles could allow more precise estimates of mortality inequalities. These limitations, largely driven by data availability, have been explicitly acknowledged to provide a balanced interpretation of our results.

Conclusions

The study on gender and income inequalities in longevity among Spanish retirement pensioners aged 65+ reveals several key findings. First and foremost, life expectancy at age 65 (LE_{65}) follows a clear and consistent socioeconomic gradient: higher pension income (PI) groups live significantly longer than lower groups (RQ_1), and these differences remain statistically significant across the study period. The greatest disadvantage concerns men in the lowest PI group (G_1), who not only experience the shortest LE_{65} but also face the greatest uncertainty in the length of life.

Female pensioners consistently have higher LE_{65} than their male counterparts, regardless of PI level. However, the evolution of LE_{65} varies by gender, with males in the highest PI group (G_4) generally living longer than those in the

lowest PI group (G_1). Trends in inequality evolved differently by gender (RQ_2–RQ_3): among men, disparities between G_1 and G_4 widened initially and then narrowed, while among women, inequalities were smaller and fluctuated more modestly but persisted throughout. Importantly, socioeconomic and gender disparities are most pronounced in the most disadvantaged group (G_1), where inequalities have deepened over time.

Additional longevity indicators provide complementary answers to our research questions (RQ_4–RQ_6). Median age at death (Md_{65}), modal age at death (M_{65}), and interquartile range (IQR_{65}) reveal distinct patterns compared to LE_{65}. While M_{65} attenuates measured inequalities relative to LE_{65}, lifespan variation indicators emphasize the heightened uncertainty among disadvantaged males in G_1. Together, these findings show that each indicator highlights a different dimension of inequality: LE_{65} best reflects the socioeconomic gradient; M_{65} captures the central tendency of survival; variation indicators inform about inequality in the distribution of lifespans – each with distinct policy implications.

In addition, the study places pensioners in the context of the general Spanish population (RQ_5). Longevity improvements have been observed across the entire society, but pensioners exhibit sharper socioeconomic gradients by income group, making PI a crucial stratifier of inequalities in older ages.

Comparatively, Spain exhibits distinctive trends in longevity inequalities. While many high-income countries such as the United States of America, Canada, and Italy show widening disparities in life expectancy by income level, Spain's trends are unique. The relative differences in LE_{65} for females are smaller and have slightly decreased, contrasting with countries such as Sweden and Germany. However, Spain shows increasing gender-based disparities in longevity among lower-income groups, especially among men in G_1, a pattern less common elsewhere. This makes the double disadvantage of low-income males in Spain particularly salient in international perspective.

These findings emphasize the need for targeted policies to address socioeconomic inequalities in longevity and improve the well-being of disadvantaged pensioners in Spain. Prior research on longevity inequalities has highlighted both structural factors beyond pension income and pioneering works within the pension system itself. On the one hand, cohort-level improvements in educational attainment (Solé-Auró and Lozano, 2019), together with persistent educational gradients in health and morbidity (Bramajo et al., 2024), underline the role of structural determinants. On the other hand, pioneering studies by Pérez-Salamero González, Regúlez-Castillo and Vidal-Meliá (2021) and Pérez-Salamero González et al. (2022) analysed mortality stratification by pension income, taking into account differences between contributory regimes (the self-employed workers scheme versus the general scheme). However, these studies focused exclusively on men, leaving aside women's trajectories. Our contribution

builds on this line of research by extending the focus to both genders, covering the entire population of retirement pensioners, and applying a multidimensional set of indicators. LE_{65} serves as a benchmark for socioeconomic gradients; M_{65} and Md_{65} refine the measurement of central survival; and lifespan variation indicators highlight the uncertainty of the ageing process, especially among disadvantaged groups. Together, these findings reinforce the importance of adopting a multidimensional approach when designing equity-focused longevity policies in Spain.

Last but not least, reducing socioeconomic disparities in longevity can only be partially addressed through pension income policies alone, and ultimately requires a broader multidisciplinary perspective that goes beyond the demographic and actuarial focus of this study.

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Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Integrating social protection and occupational health services: A scoping review

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Abstract Human health is shaped by physiological factors and by social, environmental, behavioural, and political conditions. Annually, occupational risks are a major contributor to a significant number of avoidable deaths and disability-adjusted life-years. Addressing such determinants requires action beyond the health sector, with increasing recognition of the value of multisectoral approaches to achieving health equity. Social protection and occupational

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ACR, AI, DL, FB, GAV, LT, MN, TA contributed to the design of the scoping review and the definition of the research questions. AI, MN, DL developed and submitted the research protocol for registration. The search strategy was performed by FB in collaboration with MN, AI and LT. TA and GAV separately identified and selected relevant documents from the Covidence platform, and MN acted as an inter-judge in case of non-consensus. TL and ACR were responsible for validating the relevance of each article. The draft narrative was prepared by NB, LT, ACR and AI, the final version of which was reviewed and approved by all authors. Special thanks go to Mathilde Mailfert and Marie Stijns (Social Protection Department, International Labour Office) for having reviewed and provided editing support for a preliminary draft.

health services systems both address these determinants of health and share a public health objective: preventing occupational injuries and diseases, supporting healthcare access, and facilitating rehabilitation. Among social protection schemes, social health protection plays a core role. This scoping review identifies documented linkages between social health protection and occupational health services in the global literature, highlighting both promising practices and coordination gaps between these two sub-systems. Strengthening these linkages through intersectoral policy and practice can reinforce both systems, particularly in the face of global crises such as climate change. To our knowledge, this is the first mapping of the published literature on this issue.

Keywords social protection, occupational health, health service, health policy, ILO Convention, research method, international

Introduction

Human health is shaped not only by physiological factors, but also by the conditions in which people are born, grow, live, work, play and age – along with the systems and forces influencing them, including social, environmental, behavioural, and political factors (Marmot, 2001). The working environment represents a key determinant of health. Addressing these determinants requires action across policy areas beyond the health sector, including education, safe drinking water, sanitation and hygiene (WASH), housing, transportation, and food security.

Central to this intersectoral approach are social protection schemes – covering healthcare, employment injury, and occupational diseases – and occupational health services (OHS), which aim to improve the health of working populations and wider society. Though their mandates differ, both share a common public health objective: promoting health, preventing (occupational) injuries and diseases, supporting access to care, and enabling rehabilitation. In addition to the possible health gains, improving coordination and identifying synergies between OHS, social health protection and employment injury insurance can also contribute to the achievement of large social and economic gains, whether in relation to safer work environments, reduction in human harm, reduced

productivity losses, and reduced pressure on social security funds, among other benefits.

However, despite their importance, both social protection – particularly social health protection (SHP) – and OHS face persistent coverage gaps. Globally, only 10–15 per cent of workers have access to OHS (Buijs, Gunnyeon and van Weel, 2012). In 2019, an estimated 395 million workers experienced non-fatal work injuries, while 2.93 million workers died from work-related causes, 81 per cent due to disease (Takala et al., 2024). Social protection coverage also remains limited: only 36.4 per cent of women with newborn infants receive maternity benefits, and just over half – 56.1 per cent – of the global working-age population is covered for sickness benefits, while 37.4 per cent is covered for work injury benefits (ILO, 2024). While two-thirds of the global population are covered by social health protection schemes, more than one billion incurred catastrophic health spending in 2019.[1]

Despite clear complementarities, international labour and social security standards provide little guidance on coordination between social protection and OHS systems. This scoping review documents existing collaboration efforts between institutions responsible for OHS and social protection, identifies synergies between the two sub-systems that can be scaled and replaced, and concludes by drawing lessons to inform both policy and research.

Definitions and the International Labour Organization's normative framework

Social protection is defined as a set of policies and schemes designed to reduce and prevent poverty, vulnerability, and social exclusion throughout the life cycle and ensure human dignity. It encompasses a wide range of instruments, primarily social insurance and non-contributory provisions, including social assistance, with most systems combining both. According to the International Labour Organization (ILO) Convention on Social Security (Minimum Standards), 1952 (No. 102) and ILO Recommendation on Social Protection Floors, 2012 (No. 202), social protection should at a minimum ensure access to health care without financial hardship – including maternity care – and income security throughout the life cycle.

Several normative instruments[2] enshrine the universal right to health and outline the minimum levels of protection to be guaranteed by national systems. These instruments support diverse approaches to healthcare access, including

1. See World Health Organization, The Global Health Observatory – Explore a world of health data.
2. Including the ILO Medical Care Recommendation, 1994 (No. 69), and ILO Medical Care and Sickness Benefits Convention, 1969 (No. 130).

solidarity-based financing. Income security during maternity and sickness is also mandated under ILO Convention No. 102 and ILO Recommendation No. 202, contributing to achieving health objectives alongside access to care without financial burden. Together, these elements form the foundations of social health protection (SHP). Further, ILO Convention No. 102 and the ILO Convention on Employment Injury Benefits, No. 121 (1964), outline minimum standards for employment injury and occupational diseases benefits, including income security during incapacity or reduced capacity to work, and access to medical care.

The ILO Convention on Occupational Health Services, No. 161 (1985), defines OHS as preventive services that advise employers, workers, and their representatives concerning how to maintain safe and healthy working conditions. It outlines core OHS functions, such as risk assessment, health surveillance, ergonomics, workplace adaptation, emergency care, and contributions to rehabilitation, training, and accident analysis.

The normative frameworks for social security and OHS provide several opportunities for coordination. Both systems share the goal of maintaining and restoring health – OHS primarily within the workplace, and social protection, particularly SHP, both within and beyond it. Their functions are complementary: OHS focuses on prevention, while social protection, particularly the employment injury insurance (EII) branch, provides compensation and care in cases of work-related harm.

Governance presents another opportunity for synergy: ILO Convention No. 161 allows for various organizational models for OHS, including integration with social security institutions – opening space for operational coordination between the two systems.

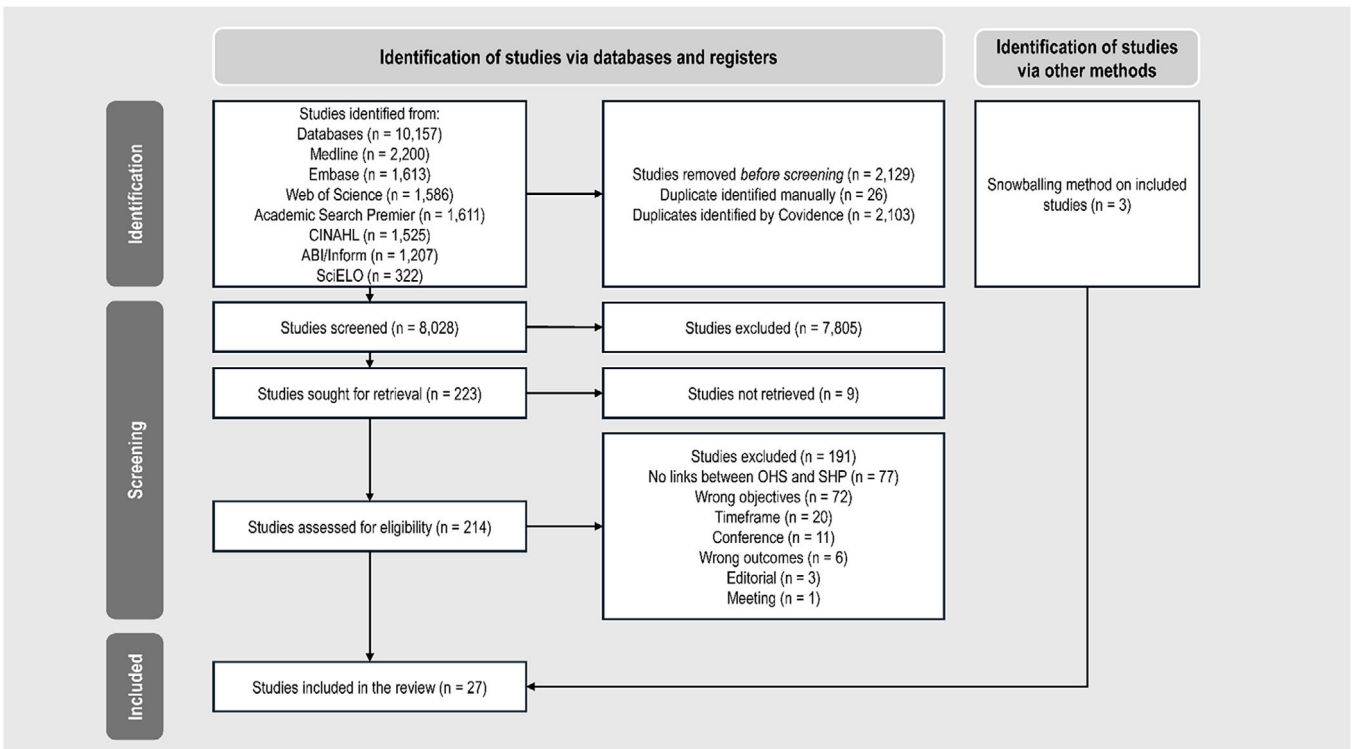
Methodology

This study used the scoping review methodology developed by Arksey and O'Malley (2005) (Figure 1) which is suitable for disciplines with emerging evidence where systematic reviews are not feasible due to sparse or limited data (Arksey and O'Malley, 2005). Scoping reviews are useful for identifying knowledge gaps and mapping literature that is complex, scattered, or fragmented (Munn et al., 2018).

Research questions

The review aimed to identify, describe, and analyse institutional linkages between OHS and social protection systems globally. It focused on answering two main questions:

Figure 1. *PRISMA Chart*



Source: Authors' elaboration.

- In which countries are institutional linkages between OHS and social protection systems reported?
- What does the existing literature reveal about the nature of these relationships, and can a typology be developed?

Institutional linkages are defined as direct, regularized relations between two or more institutions – formal or informal policies, processes, or programmes linking SHP systems and entities organizing OHS. Institutions include government agencies and semi/private organizations with oversight or administrative roles.

Identification of relevant studies

The search was launched in October 2022 across databases, which we list in Appendix 1.[3] Snowballing was used to identify additional papers. All results were uploaded to Covidence, a systemic review tool, where duplicates were removed automatically or manually.

- Inclusion criteria: Academic and grey literature published between 2000–2022, in French, English, Spanish, Russian, Turkish, or Portuguese, reporting at least one OHS–social protection linkage.
- Exclusion criteria: Articles without an institutional linkage, not classified as academic nor grey literature, nor published as editorials, reviews, nor letters. Articles in other languages were excluded.

Although the focus was on OHS-SHP linkages, broader social protection-related terms were included in the search strategy.

Selection of relevant studies

A two-step selection process was applied: i) title and abstract screening and ii) full-text screening. Two independent reviewers conducted a double-blind review, with arbitration by a third. The ILO staff members of the authoring team conducted cross-evaluations until consensus was reached. Figure 1 illustrates the study identification process.

Data charting, collating and summarizing and reporting of results

Results were presented using qualitative content analysis, which applies systematic coding to subjectively interpret data, identify themes, and reveal patterns (Hsieh and Shannon, 2005).

3. See Table A.1. This article is further supplemented by an online Appendix (developed by the authors and made available to readers). For an outline of the search strategies used for each of the specialized databases as well as the number of results, see Supporting information.

Results

Out of 10,160 papers identified through database and grey literature searches, as well as snowballing, 26 publications (see Table A.2 in Appendix 2) met the review objectives and were included (see Figure 1). The studies were published in French, English, Russian, Spanish, and Portuguese. Sixteen articles focused on European contexts, eight on the Americas and two on the Asia and the Pacific region. No articles were found on the Arab States and African countries, likely indicating a lack of documentation rather than an absence of linkages.

The nature of the articles and methodologies adopted varies widely, ranging from annual account reports to legislative and historical reviews or articles reporting the results of pilot schemes. In turn, the level of detail provided about the linkages in the identified articles was often very limited and, thus, crucial information that would serve to inform policy and practice in relation to coordination between OHS and SHP sub-systems was seldom found in the identified literature.

What does the existing literature tell us about the nature of these relationships and is it possible to build a typology of linkages?

There are four main findings:

- **Diversity of linkages**. Linkages vary significantly across contexts depending on the institutional architecture of SHP, organization of OHS functions, their interaction with EII, and levels of system fragmentation, making it difficult to establish a unified typology.
- **Three-way interactions**. Many linkages also involve EII, highlighting the difficulty of isolating the relationship between OHS and SHP from the EII branch.
- **Multiple linkages**. Most contexts show several linkages. Some, such as Spain, demonstrate intentional multi-level coordination (see Box 1). In Finland and Russia, multiple linkages exist but are not described as being coordinated.[4]
- **Legal basis**. Some linkages are mandated by law; others stem from pilot projects, often lacking evidence of institutionalization. In some contexts, OHS rules are embedded in social protection laws. These intersectoral arrangements emphasize the need for legislation to clarify roles and formalize collaboration.

4. For example, in Finland, the social health insurance reimburses employers for their expenditures on OHS, which are carried out by the employer or private or public health services. It was identified that private health insurance companies are setting up their own health centres and hospitals in which OHS functions are being delivered. Here, linkages of two types are identified (financial and direct service delivery), but are not presented as being connected or coordinated in any way.

Box 1. *The Integral Health Surveillance Programme, Spain*

Spain's Integral Health Surveillance Programme, launched in 2002, aimed to standardize the monitoring of workers exposed to asbestos. Key activities implemented under the programme included:

- Development of a registry of exposed workers.
- Support to access post-exposure health examinations.
- Continuous post-exposure health surveillance.
- Promotion of the recognition of asbestos-related diseases (García Gómez et al., 2006).

The programme fostered several linkages across OHS, the NHS and the social protection systems:

- NHS provided health surveillance for retired workers.
- Diagnosed workers were referred to social protection for disability benefits.
- The social insurance system funded preventive examinations.
- Data were shared across multiple institutions.
- NHS professionals received training on occupational exposure.

By 2012, the programme had registered over 35,630 workers (García Gómez, 2014).

In many contexts, multiple linkages of different natures were identified from the literature. These have been grouped into general themes to describe them in more detail.

Policy engagement

Linkages were found relating to the institutional architecture of OHS, SHP, and social protection more generally, as well as levels of engagement of social protection or health authorities in OHS policy development:

- In Paraguay and Colombia, legislators historically considered OHS and social protection (including SHP) policies together and legislate in a joint and integrated fashion (Flores, Giménez Caballero and Peralta, 2017; Álvarez Torres and Riaño Casallas, 2018).
- In Colombia and Quebec, Canada, there has historically been one single institution with responsibilities for both OHS policy and implementation and the administration of the EII branch (Ferre, 2010; Álvarez Torres and Riaño Casallas, 2018). In France, for agricultural workers, OHS and all nine contingencies of social protection are administered by the Agricultural Mutual Benefit Societies (*Mutualité sociale Agricole* – MSA) (Lancry et al., 2007). This institutional organization opens opportunities for many linkages.

• Again in France, the Social Security Directorate (*Direction de la sécurité sociale*) also participates in prevention policy (Ferre, 2010).

Financing

Financial linkages include direct financial transfers between OHS, EII and SHP, or to service providers/employers. The structure varies widely:

• In Finland and Russia, employers are responsible for the purchase or delivery of (some) OHS and are partially reimbursed by the social insurance system (Tynkkynen et al., 2016; Keskimaki et al., 2019; Alshits and Kulkova, 2018).

• In Quebec, Canada, OHS professionals in enterprise programmes are salaried workers of the main public health insurer, which is reimbursed by the body managing OHS and EII for the services they deliver (Ferre, 2010).

• In Poland, regional OHS centres are co-financed by the national health insurance and other sources (Rydlewska-Liszkowska, 2002).

Other articles describe cost shifting between social protection branches. In Taiwan (China), costs previously covered by the EII scheme shifted to the national health insurance after its introduction (Cheng, Chung and Cheng, 2019). Similarly, in the United States, Medicare and Medicaid cover costs from underreported or inadequately compensated cases of work injury or occupational disease (O'Leary et al., 2012). In France, the EII scheme for non-agricultural workers makes annual payments to the National Sickness Insurance Fund for non-agricultural workers (*Caisse nationale de l'assurance maladie* – CNAM) to compensate for the costs of work-related injuries or diseases it bears due to the under-reporting or under-detection thereof (Commission des comptes de la Sécurité sociale, 2021).

Delivery of OHS functions by National Health Services

Some countries integrate OHS delivery into National Health Services (NHS), as foreseen by the ILO Occupational Health Services Recommendation, (1985) No. 171:

• Brazil's Unified Health System (*Sistema Único de Saúde* – SUS) provides OHS via Reference Centres (Cerest), offering care and surveillance (Aguiar and Vasconcellos, 2015; Balista, Santiago and Filho, 2011).

• In Italy, employers must arrange or contract OHS for staff not covered by the NHS (Persechino et al., 2017).

• NHS-based OHS delivery is also found in the United Kingdom and in Ireland (Jain et al., 2021).

Occupational health included in the benefit packages of national/social health insurance

In several countries, health insurance engages in the delivery of some OHS functions.

- Netherlands: Mandatory health insurance covers medical care for injured employees (Cheng, Chung and Cheng, 2019).
- Germany: Health insurance funds offer workplace health promotion while other functions fall under EII and OHS authorities (Jain et al., 2021).
- India: In a campaign in Bengaluru, the capital city of the state of Karnataka, social health insurance staff undertook workplace inspections (Nagaraja et al., 2013).
- Finland: A voluntary insurer launched a hospital chain in 2013 that provide OHS (Keskimaki et al., 2019).
- France: Multiple actors participate in OHS and social health protection:
  - The CNAM funds regional prevention activities (Ferre, 2010).
  - Under a pilot, occupational physicians referred socio-economically vulnerable workers for preventive check-ups covered by the national health insurance (Labbe et al., 2012).
  - Rehabilitation programmes support post-injury recovery (Leiva et al., 2021).
  - Complementary health insurance companies have begun engaging in the delivery of preventive OHS functions (Lecomte-Ménahès, 2022).

Social insurance branches fulfilling some OHS functions

Some national social insurance funds, primarily through EII schemes, directly engage in OHS functions:

- The social insurance fund in Russia engages in the analysis of occupational injuries and diseases at the enterprise level. Based upon that analysis, advice to companies is provided on potential corrective measures (Alshits and Kulkova, 2018). Similarly, in France, enterprises with an important number of claims to the EII branch are monitored by controllers and prevention specialists from the general social insurance system (*Caisses d'assurance retraite et de la santé au travail* – CARSAT) (Lecomte-Ménahès, 2022).
- In Germany and the Netherlands, the EII branches deliver OHS functions for specific categories of the population (Jain et al., 2021; Hansen et al., 2019; van Beurden et al., 2012).
- In Brazil, Italy, and the Netherlands the EII branches engage in rehabilitation activities (van Beurden et al., 2012; Barreto de Miranda, 2018; Jain et al., 2021).

Referrals and information sharing

Referrals and information sharing between sub-systems was identified in two articles.

- In the above-mentioned campaign in Bengaluru, India, workers identified by the Employees' State Insurance Corporation (ESIC) physicians as "needy" were referred to the ESIC hospital that had launched the campaign (Nagaraja et al., 2013).
- In Italy, the article by Persechino et al. (2017) reports on the communication between occupational physicians (OPs), who are hired by companies, and general physicians (GPs) working for the NHS.[5]

Discussion

This scoping review aims to identify and describe connection points between OHS sub-systems and social protection schemes, with a specific focus on SHP. Below are several cross-cutting reflections from the literature.

Paucity of literature

Drawing robust lessons from international experience is challenging due to:

- the varying definitions and understandings of OHS and social protection – and especially SHP,
- the diversity of actors involved,
- the range of linkages described,
- the scattered nature of the literature,
- the uneven depth of information provided in the literature.

Overall, research on integration or linkages between these systems remains limited and is largely concentrated in high-income countries. This scarcity prevents identification of enabling or constraining factors to coordination, which could inform intersectoral approaches.

This mirrors findings from other reviews on intersectoral action in health, which similarly highlight gaps in research availability, particularly in low-income and middle-income countries (van Rensburg and Brooke-Sumner, 2023); limited evidence on the impacts of intersectoral action (National Collaborating Centre for Determinants of Health, 2012; Ndumbe-Eyoh and Moffatt, 2013); and a lack of knowledge on the operationalization of such approaches (Amri, Chatur and O'Campo, 2022; Errecaborde et al., 2019).

5. However, the study did not collect information about the interactions that would enable an evaluation of the quality or value of the collaboration, how this informs further action by occupational physicians, or its impacts on worker health.

Ambiguity in the relationship between linkages and coordination

Most articles do not assess whether linkages lead to strengthened coordination between institutions responsible for OHS and social protection, including SHP. This often stems from a lack of detailed information on the institutional context and the nature of the linkages, making it unclear whether they reflect or lead to sustained coordination (e.g. Rydlewska-Liszkowska, 2002; Nagaraja et al., 2013; Alshits and Kulkova, 2018; Commission des comptes de la Sécurité sociale, 2021; Daubas-Letourneux, 2008; Keskimaki et al., 2019; Cheng, Chung and Cheng, 2019; O'Leary et al., 2012; Hansen et al., 2019; Leiva et al., 2021; Flores, Giménez Caballero, and Peralta, 2017; Labbe et al., 2012).

Only a few articles describe positive institutional coordination. This includes Spain's integrated health surveillance programme, designed to strengthen coordination across levels (García Gómez et al., 2006; García Gómez, 2014), and France's MSA, which implements a multidisciplinary approach across OHS and social protection (Lancry et al., 2007).

Other studies describe some coordination but highlight persistent challenges – such as weak collaboration between occupational and general physicians in Italy (Persechino et al., 2017), overlapping responsibilities in France (Lecomte-Ménahès, 2022), or fragmented institutional landscapes in Brazil's SUS (Aguiar and Vasconcellos, 2015; Balista, Santiago and Filho, 2011).

Recognizing the work-related nature of an injury or disease

Under-reporting of occupational diseases is a recurring theme in the literature – an issue that does not only affect the countries in which linkages have been identified in this review.[6] This can prevent affected workers from accessing healthcare services and income support under EII schemes. This is the subject of many linkages within the literature, which widely reports on the efforts to improve recognition of work-related conditions, including enhanced diagnostic capacity, inter-institutional coordination, better surveillance, and financial arrangements – such as those implemented in Brazil, France and Spain.

Under-reporting also reflects broader challenges in how social protection systems distinguish between "health" and "occupational health" – particularly regarding eligibility, benefit levels, and administrative processes. From the individual worker's perspective, health is not experienced in silos. Workers often seek care from general physicians rather than occupational physicians, whether conditions are work-related (or not), but most systems fail to reflect this perceived reality. This separation has significant consequences for both workers

6. See, for example, the experience in Scandinavian countries in Work today and in the future.

and the financial sustainability of social protection systems (Cheng, Chung and Cheng, 2019).

Implications for coverage, quality and comprehensiveness

Low coverage of OHS and EII schemes is well documented, especially in systems where employers are liable for compensation or where informal workers or self-employed workers are excluded. Limited coverage weakens protection for workers and their access to preventive efforts, but also shifts the financial burdens onto SHP systems, as observed in Taiwan (China) (Cheng, Chung and Cheng, 2019). Integrating selected OHS functions into SHP schemes could help extend coverage and improve access, especially for informal workers. This is the premise of calls for the integration of OHS within national primary healthcare or health promotion activities, which can extend access to certain functions of OHS, particularly to self-employed workers and those in the informal economy (see for example Govender and Rajaram, 2018; Buijs, Gunnyeon and van Weel, 2012; Dias and Lima, 2022).

However, integration does not automatically translate into better coverage in practice. Several studies flag up challenges with integrating OHS into NHS systems, particularly regarding the quality and comprehensiveness of services. In the United Kingdom, a lack of occupational health expertise among NHS staff limits service effectiveness (Jain et al., 2021). In France and Brazil, concerns have been raised about service quality when OHS is delivered, respectively, by complementary insurance or within the SUS (Lecomte-Ménahès, 2022; Aguiar and Vasconcellos, 2015). Integrating OHS into primary healthcare has been proposed to expand its reach (Buijs, Gunnyeon and van Weel, 2012). Although this review did not focus on integration into primary care units, findings from NHS-based models offer relevant insights, especially regarding trade-offs between broader coverage and maintaining service quality and comprehensiveness.

Limitations

Fragmentation in the literature and difficulties in identifying linkages between systems posed challenges during article selection. These were mitigated through collaborative discussions among researchers, librarians, and ILO experts, which supported consistent interpretation of the objectives and facilitated the selection and extraction process.

In turn, the identified literature was predominantly focused on Europe, with limited material from low-income and middle-income countries and none from the Arab States or Africa. This likely reflects gaps in documentation rather than

the absence of linkages and potential further examples of coordination. Expanding the geographic scope of future research is essential, and the case studies conducted as part of this project aim to contribute to addressing this gap.

Conversely, the linguistic diversity of the review team proved an asset, enabling access to a broader range of sources and highlighting the importance of multilingual reviews when studying emerging or cross-sectoral topics.

Conclusion

The scoping review has aimed to document evidence on the linkages that exist between OHS systems on one hand, and social protection systems with a specific focus on SHP on the other. The paucity of information identified in the literature, combined with the diversity in the nature of the linkages, made the elaboration of a typology and identifications of good practices difficult. In turn, the identified literature pertains largely to high-income countries, with little documentation of linkages in low-income and middle-income countries. Filling these knowledge gaps is crucial for better promoting synergies and collaboration between OHS, social protection and SHP systems. Particular emphasis needs to be placed on expanding investments in prevention efforts to address the root causes of occupational risks, efforts which are highly cost effective, yet under-resourced and not sufficiently prioritized. Further, health at work cannot be easily distinguished from health outside of work at the individual level, and there is growing consensus that inter-sectoral approaches are central to addressing the social and environmental determinants of health and thereby reaching the objective of health equity. Stronger coordination may also contribute to the achievement of significant social and economic benefits, including promoting safer work environments, reducing human harm, reducing productivity losses, and reducing pressure on social security funds, among other benefits. Based on the ILO's normative frameworks on social protection and OHS, there is significant room to enhance integrated approaches both in policy and in practice.

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Appendix 1

Methodology and search strategy

The search strategy was informed by a conceptual framework developed by the ILO staff members of the authoring team based on existing knowledge and hypotheses about potential linkages between OSH and social protection systems. Four links were conceptualized which informed the search strategy, the selection of articles, and the analysis of the documents.

Identification of relevant studies

Relevant studies were identified in the following specialized databases:

- Medline (Ovid)
- Embase
- CINAHL
- Academic Search Premier
- Web of Science
- ABI/Inform (ProQuest)

Table A.1. *Linkages*

Linkage	Definition
Service provision	A package of OHS can be delivered in primary healthcare centres that are part of the network of health service providers who deliver social health protection benefits.
Financial linkages	The social protection system can finance OHS in all or some sectors, or they can share a common source of financing
Referral mechanisms	Workers undergoing health promotion activities in the workplace such as screening and testing are referred to social protection schemes or health/social care benefits.
Extension of coverage	Mutual support from social protection and OHS for the extension of coverage to informal economy workers and/or self-employed workers. Examples here include joint awareness raising activities or register workers to social protection during health checks, etc.

Source: Authors' elaboration.

- SciELO
- Google Scholar

In total, 10,160 studies were imported into Covidence. The search strategy with keywords and descriptors was performed by a librarian (FB) in collaboration with the researcher (MN) and the ILO experts AI and TL and validated in the databases by FB. Documents were also collected from reference lists of relevant papers and suggestions from ILO professionals working on the topic.

The acquisition and selection of relevant documents allowed the targeting of the most relevant documents. Given the limited information on this topic, the first strategy for acquiring and selecting articles did not apply a broad inclusion and exclusion criteria restriction, allowing for an initial identification and selection process from 8,028 papers with the blind approach. Two research assistants (TA and GAV) separately identified and selected relevant documents from the Covidence platform. MN acted as an inter-judge in case of non-consensus. Realizing the complexity of the review topic, a second strategy of selecting and identifying relevant documents was adopted. For this purpose, 11 documents from different countries considered relevant were sent to the ILO experts (TL and AR), who were responsible for validating their relevance. Also, the ILO experts were involved in the validation of all the articles that were accepted in the full text, to ensure their relevance. This allowed the redefinition of inclusion and exclusion.

The inclusion criterions were:

- Types of publications: study is primary and secondary research and grey literature.
- Time frame: studies published from 2000 up to 2022.
- Focus areas: the study reports at least one link between social protection and OHS system. Such linkages do not need to be the primary focus of the study, but they need to be mentioned and some information of them needs to be included in the full text.

The exclusion criterions were:

- The study is an editorial, conference, or letter;
- Articles that describe OHS or social protection programmes without identifying institutional links between the two systems.

Data charting, collating and summarizing

The data extraction was multi-staged by language (Brien et al., 2010). TA and GAV extracted the documents in French, English, and Turkish; DL, LT, and ACR extracted those in Spanish, Portuguese, Russian, and German. MN validated all extracted documents. The data charting of Covidence was adapted. Descriptive and analytical features from each included document were collected.

A narrative synthesis was preferred to organize the results and create a descriptive summary, given the broad research questions. In this sense, a set of sub-questions was developed for the charting of data used to guide this stage.

Appendix 2

Table A.2. *List of included literature*

Reference	Country discussed	Is the linkage the focus of the paper?	Which systems are discussed?
Aguiar and Vasconcellos, 2015	Brazil	No	OSH and SHP
Alshits and Kulkova, 2018	Russia	No	OSH and EII
Álvarez Torres and Riaño Casallas, 2018	Colombia	No	OSH and EII
Balista, Santiago, and Filho, 2011	Brazil	No	OSH and EII
Cheng, Chung and Cheng, 2019	Taiwan (China), United Kingdom, Denmark, Netherlands	Yes	OSH and EII
Daubas-Letourneux, 2008	France	No	OSH and EII
Ferre, 2010	France and Quebec Canada	No	EII and SHP
Flores et al., 2017	Paraguay	Yes	OSH and EII
Flores, Giménez Caballero and Peralta, 2017	Spain	Yes	OSH and SHP
García Gómez, 2014	Spain	Yes	OSH and SHP
	France	Yes	EII and SHP

(Continued)

Table A.2. *List of included literature* - Continued

Reference	Country discussed	Is the linkage the focus of the paper?	Which systems are discussed?
Commission des Comptes de la Sécurité Sociale, 2021			
Hansen et al., 2019	Germany	Yes	OSH and EII
Jain et al., 2021	Australia, Canada, Finland, France, Germany, Ireland, Italy, Japan, The Netherlands, Poland, United Kingdom and the USA	No	OHS
Keskimaki et al., 2019	Finland	No	OSH and SHP
Labbe et al., 2012	France	Yes	OSH and SHP
Lancry et al., 2007	France	No	EII and SHP
Leão and Castro, 2013	Brazil	No	OSH and SHP
Lecomte-Ménahès, 2022	France	Yes	OSH and SHP
Leiva et al., 2021	France	Yes	OSH and SHP
Barreto de Miranda, 2018	Brazil	No	OSH and EII
Nagaraja et al., 2013	India	Yes	OSH and SHP
O'Leary et al., 2012	US	No	EII, disability and SHP
Persechino et al., 2017	Italy	Yes	OSH and SHP
Rydlewska-Liszkowska, 2002	Poland	No	OSH and SHP
Tynkkynen et al., 2016	Finland	No	OSH and SHP
van Beurden et al., 2012	Netherlands	No	OSH and EII

Source: Authors' elaboration.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Predicting disability pension risk among public-sector employees in Finland: A new evaluation tool for employers

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Abstract In this study, we use unique research data to investigate the risk of exit from the workforce on the grounds of the award of a disability pension under the statutory public-sector pension scheme in Finland. Statistical analysis yields two indicators: the risk for permanent disability retirement and the critical duration of sickness absence days in public-sector occupations. The analysis is based on a logistic regression model where the outcome is retirement on a disability pension, with sickness benefit spells and other individual background information used as covariates. The results underline the importance of minimizing sickness absences and their duration and reveal differences in the risk rate between occupations. We conclude that the proposed risk model is a promising tool that can help employers and the pension industry prevent permanent disability.

Keywords disability benefit, health service, occupational health, sick leave, social security administration, Finland

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Data statement: The research data is confidential and thus not accessible.

Introduction

While the number of new cases of workers leaving employment prior to the retirement age to receive a disability pension has been falling over the past decade in many countries, complex and persistent challenges remain because of the continuing fragmentation of working lives. In statutory pension systems, the burden of pension costs is borne by pension providers and employers as well as employees. The consequences of work-related disability and disability pensions in particular are wide-ranging and extend beyond the pension industry because of their significant effect on employers and employees facing challenges with work ability.

Work ability often diminishes progressively over time, which means there are multiple windows of opportunity for preventive intervention.[1] Permanent exit from the workforce on the grounds of disability is typically preceded by sickness absence spells, which is why occupational health care provided by employers so often focuses on early intervention. In addition, statutory pension systems, including national pension systems, include various sickness and disability benefits for the working-age population.

In the Finnish context, there is a wealth of literature on the factors contributing to the claiming of disability pensions and the occurrence of sickness absences. Recently, much research has been devoted to labour market outcomes after sickness absence spells (e.g. Leino-Arjas et al., 2021; Laaksonen et al., 2023; Perhoniemi, Blomgren and Laaksonen, 2023). In the City of Helsinki, Lallukka et al. (2023) studied occupational trajectories before and after the award of (permanent as well as partial) disability pensions. The Finnish Institute of Occupational Health has published work-ability forecasts and workload factors,[2] while Laaksonen et al. (2018) and Shiri et al. (2021) have explored the number of working days lost due to sickness absences or disability pensions.

Internationally, there has similarly been much research on this topic. In Denmark, Lund et al. (2008) studied the associations between disability risk and sickness absences (2008) and, in Sweden, Karlsson et al. (2008) and Kivimäki et al. (2007) addressed the same subject. In the Norwegian studies by Gjesdal et al. (2004) and Gjesdal and Bratberg (2003), age, underlying illness, long absences, earnings and education were identified as predictors of disability risk. A recent study by Bethge, Spanier and Streibelt (2021) applied an approach similar to the one adopted in this current study, including sickness absences of all durations and unemployment spells, to examine the risk of permanent work

1. For a critical appraisal of this discussion, see OECD (2022).
2. See Online work ability forecast calculator.

disability. An outline of the national sickness benefit systems implemented across Europe can be found in Spasova, Bouget and Vanhercke (2016).

In this study, we focus on early predictors of permanent disability. Using a logistic regression model as our analytical tool, we present results of a risk analysis that shows the occupation-level risk for filing a disability pension application in the near future. We also propose an indicator for employers and pension providers that uses up-to-date register data to establish the critical duration of sickness absence spells. The analysis is based on unique research data, which includes information on employees' working life as well as their history of sickness absence spells, including those of short duration, as well as their history of disability pension applications.

In Finland, pension providers and employers are using new digital technologies to streamline the pension application process (e.g. information gathering, stratifying pension applications, automatic decision-making). These advances have likely contributed to strengthen public trust in the pension system (e.g. Hyde, Dixon and Drover, 2007; Vickerstaff et al., 2012; Mailes, Carrasco and Arcuri, 2021). The possibilities of information and communication technologies (ICT) are beyond the scope of this study, but we do aim to deepen understanding of how employers might benefit from the application of statistical modelling and ICT in detecting early indicators of work disability risks. Up-to-date information is crucial in proactive risk management at the occupation level and is thus highly valuable for human resources (HR) executives and occupational health care bodies.

In this article, we examine the risk of exiting the workforce on the grounds of being awarded a disability pension. The data and study design allow us to address the following principal questions:

- Which public-sector occupations have an increased risk of workforce exit on the grounds of disability, and how does the risk vary between age groups?
- How can statistical modelling be used in providing digital tools for the employer to evaluate the risk of workforce exit?

Given the aims of our study, it is essential that we select a statistical method that is capable of detecting rare risks at the occupation level. One such technique is logistic regression. We have chosen to use logistic regression, most importantly, because we need to be able to use the modelling results to estimate the level of risk as a parameter in digital tools, but we are not interested in the order in which the risk materializes in certain populations.

This study has three aims. First, we introduce a statistical model for workforce exit on the grounds of the award of a disability pension, based on simple yet comprehensive and up-to-date data. Second, we use this model to describe the factors affecting the risk of permanent disability and introduce an early occupation-level indicator of diminishing work ability based on sickness absence

days and other covariates. Third, we report tentative results on the costs of sickness absences for one major local government employer in Finland, outlining the potential for developing digital tools for practical risk management.

Disability pension schemes for public-sector employees in Finland

The statutory disability pension system in Finland includes several pensions and benefits for those with reduced work ability (see SSA and ISSA, 2018). There are two major types of pension: we define these as "fixed-term" pensions (cash rehabilitation benefit and partial rehabilitation allowance) and pensions "paid until further notice" (disability pension and partial disability pension). The cash rehabilitation benefit or partial rehabilitation allowance is granted if it is thought that the employee's ability to work can be restored by means of treatment or rehabilitation. In addition, a years-of-service pension has been available since 2017 for those with permanently diminished work ability but who are not yet eligible for the disability pension. The number of years-of-service pensions granted is negligible compared to disability pensions.

The pension rules state that employees may be granted disability pensions and benefits if they have not reached retirement age and if their ability to work has been reduced for at least one year because of illness, injury, or disability. The rules also say that persons drawing a partial disability pension are allowed to earn an income within the earnings limits. In January 2023 that limit was set at 922 euros (EUR) a month (about 34 per cent of the median public-sector wage; see Finnish Centre for Pensions, 2021). The years-of-service pension is granted to persons older than age 62 who have worked for 38 years or more in strenuous and exacting work.

Beyond disability pensions, there is also a benefit called occupational rehabilitation, which is available for employees with illness or injury who have been employed in recent years but who are deemed to be at risk of having to exit the workforce and to receive a disability pension in the next few years. Occupational rehabilitation includes work trials, job coaching, education, apprenticeship training, career counselling, and other actions.

The universal basic pension system also includes schemes and rules to assist those with severely diminished work ability. These schemes include sickness allowance, rehabilitation allowance, rehabilitation, and disability pensions (rehabilitation subsidy or disability pension). A pension may be granted after the applicant has received sickness allowance for about one year. There are specific rules in the universal basic pension system for disability pensions and benefits. In the statutory pension systems, disability pensions and benefits will only be granted on submission of a medical statement. For a more detailed account of

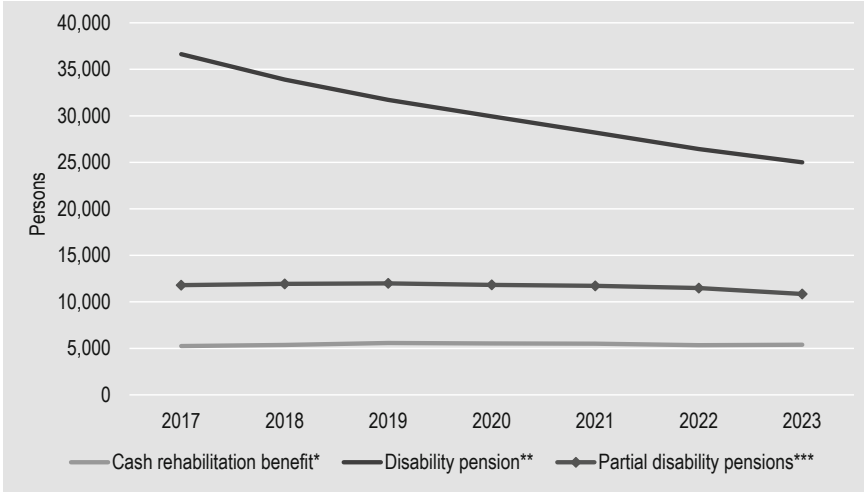
the Finnish statutory pension system, see Kuivalainen et al. (2020); Lähderanta et al. (2022); and OECD (2023).

Earlier studies have highlighted some differences in disability retirement between public-sector and private-sector employees in Finland. These differences mainly stem from differences in age, gender, and occupational structure as well as in employer practices. In the public sector, it is more common to utilize partial pensions as the first disability pension than it is in the private sector. In both sectors, fixed-term pensions are the most common form of first pension, but the majority of disability pensions are permanent, being paid until further notice (see Polvinen, 2021; Polvinen and Laaksonen, 2023; Finnish Centre for Pensions, 2024a).

As shown in Figure 1, the number of disability pension recipients has decreased notably (by 32 per cent) since 2017. The number of partial disability pension recipients has also decreased, by 8 per cent, while the number of cash rehabilitation benefit recipients has increased by 2 per cent. In fact, the incidence rate of disability pensions in the statutory earnings-related pension system has halved since 2002 (see Finnish Centre for Pensions, 2024b).

Full disability pensions continue to remain the major labour market outcome for employees with persistent challenges to their work ability. The goal for the future should be to reduce the frequency of permanent disability pensions and to support the continued attachment of employees with health problems to the labour market

Figure 1. *Recipients of statutory earnings-related disability pensions in the public sector*



Notes: *=Fixed-term, **=Paid until further notice, ***=Fixed-term or paid until further notice.
Source: Elaborated by the authors from Keva's administrative registers.

via fixed-term (partial and full) disability pensions and benefits. Partial disability pensions have an added advantage in that they allow employees who are receiving a pension to continue to work. According to a recent Finnish study, the main reasons behind the decline in the number of disability pensions recipients lie, on the one hand, in the decreasing number of new disability pension awards and, on the other hand, in the fact that those receiving disability pensions are automatically transferred to the old-age pension (OA) system at retirement age. Mortality has no significant role in these trends (see Laaksonen and Rantala, 2023).

In the existing stock of disability pensioners, the main causes of disability are mental and behavioural disorders and diseases of the musculoskeletal system and connective tissue (see ICD-10; Finnish Centre for Pensions, 2024c).

Research data, measurements and methods

The initial data for our study were drawn from the administrative registers of the Finnish public-sector pension provider, Keva. Additional data on sickness absence spells were obtained from certain public-sector employers; that is, from major cities as well as well-being services in counties. A total of 21 employers provided material for this study. The data represent, roughly, a 50 per cent sample of public-sector employees and yield an approximation for employers of different sizes.

The major novelty of our study is the inclusion of sickness absence spells of all durations. The majority of earlier Finnish studies only include sickness absence spells of 9 days or longer, which are relatively rare. Therefore, these may yield biased results, given that shorter sickness absence spells may be the single most important early indicator of declining work ability.

The data set for statistical modelling consisted of 940,021 observations from 2016 to 2019. The observations concerned 340,816 employees (24.1 per cent male and 75.9 per cent female). The data were combined from three separate sources: sickness absence leave of employees reported by employers, employment information for those employers, and any pension benefits paid to the persons concerned.

Measurements of outcome

The outcome variable "DP retirement" (0=no, 1=yes) was defined as true (yes) if any disability pension payments were made to the person (pension granted) at any time during the three calendar years following the observation year. In total 19,816 observations (a prevalence of 2.1 per cent in the data set) had a true outcome variable. Note that disability pensions include all pension benefits (fixed term and paid until further notice), as we consider the medical diagnosis of

diminished work ability as a meaningful realization of disability pension risk, and the return to permanent work following receipt of any kind of disability pension in the long term is quite rare.

Measurements of predictors

The data set includes information about sickness absence spells of different durations attributed to the person during the observation year, with overlapping or back-to-back periods concatenated, provided their initiation years were the same; the person's gender and age; receipt of any previous disability pension payments (disability pension, cash rehabilitation benefit, or partial disability pension, as shown in Figure 1) and principal employer and primary occupation during the year in question. The data set included all employed personnel, regardless of whether they had any sickness absence spells. Any observations about a person receiving a disability pension during the end of the observation year had already been removed during pre-processing.

The explanatory variables include socioeconomic factors (Gender, Age (in years), Age <31 yrs, Age 43–53 yrs, Occupation risk class), SA spell-specific information (SA spells (0–4 days), SA spells (5–9 days), SA spells (10–14 days), SA spells (15–29 days), SA spells (30–44 days), SA spells (45–59 days), SA spells (60+ days), Years since 60+ SA spell, SA spell (60+ days), Number of 60+ SA days), pension history (Eligible for OA pension, Previous DP, Years since SA) and some auxiliary information (Year, Employer SA duration distribution). In the final model we also use some interactions between the explanatory variables.[3]

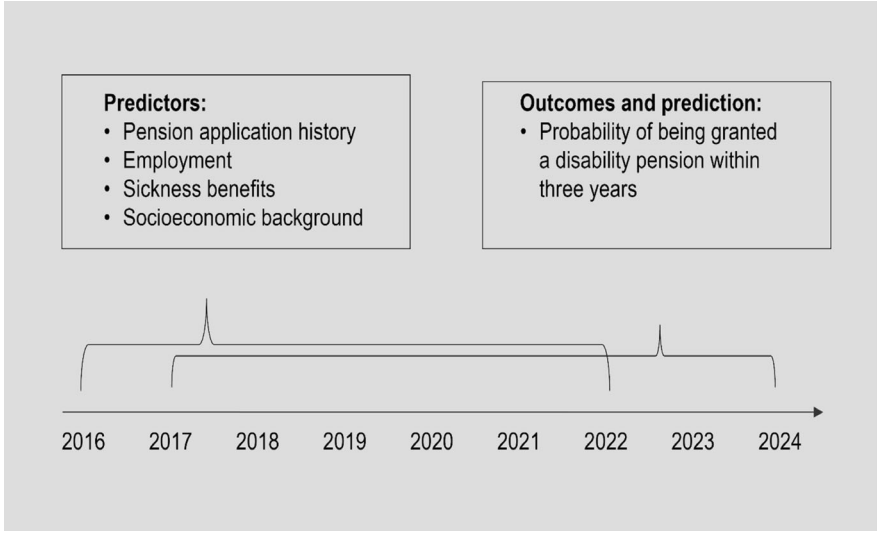
As our ultimate aim is to provide practical tools for employers, the data required are relatively limited and easy to update, yet they allow for quite accurate predictions of the risk of disability pension award.

Method and study design

The statistical tool we use for modelling the risk of drawing a disability pension is logistic regression, which has been applied in many fields. In this application it is a valid method as it yields parameters for use in digital tools and enables us to stratify high and low risk cases. In social and actuarial science, the technique has been applied to predictive tasks (e.g. Astari and Kismiantini, 2019; Wijnhoven et al., 2023; Altwicker-Hámori, 2023). In terms of content, similar use of logistic regression modelling can be found in Bethge, Spanier and Streibelt (2021).

3. Further details on the content of all predictors are provided in Appendix Table A1.

Figure 2. *Study design and data*



Source: Authors' elaboration.

The modelling was done by using R statistical software (Wickham, 2016; Sing et al., 2005).[4] SAS was used in data pre-processing and in summarizing the results.

The study design pools the data from 2016 to 2021. In practice, one-year cross-sectional data on the predictors are used to predict the risk of drawing a disability pension in the next three years (Figure 2). The design allows us to study the in-sample probability of drawing a disability pension (e.g. predictors from 2016 and predictions for 2017 to 2019) and make out-of-sample predictions (e.g. predictors from 2021 and predictions for 2022 to 2024).

Modelling individual disability risk with logistic regression

Model candidates of varying complexity were sequentially removed in a backwards elimination process to find the most parsimonious model using only 30 predictors or less. Since the sole purpose of the model was to predict the probability of the event, we also allowed for cases where the main effects were omitted in the predictor elimination process, and only interaction terms remained. In practice, a

4. For more information, see the following online sources: *R: A language and environment for statistical computing*, posted by the Project for Statistical Computing. *Package "openxlsx"*, posted by P. Schauberger. *dplyr: A grammar of data manipulation*, posted by H. Wickham et al. *haven: Import and Export "SPSS", "Stata" and "SAS"*, posted by H. Wickham, E. Miller and D. Smith. *tidyr: Tidy Messy Data*, posted by H. Wickham, D. Vaughan and M. Girlich.

sample of 500,000 observations was marked as the teaching data set and a separate sample of 200,000 observations was used as the testing and validation data set.

The model evaluation metrics included the AIC (Akaike information criterion) and McFadden Pseudo R-Squared relative rankings on the teaching data, and the relative AUC (Area Under the Curve) score ranking on the test sample. Only models with 30 predictors or less after the stepwise elimination process were considered for the final risk assessment model. The final model had 20 explanatory variables and 30 predictors in total (including the interactions). The model AUC score on the test sample was 0.84, which can be considered a good value, given the available explanatory variables.

The explanatory variable "Occupation risk class" was constructed to identify differences in the ex-ante disability risk across occupations. All public-sector occupations were ordered into ten groups according to the observed risk in the whole data set.

Finally, the selected model was re-trained for final application with all the available observations (940,021) for which the outcome variable was known. The final coefficients of the model were obtained from the full data set and are given in Table 1. Most predictors have a statistically significant value in the selected model.

Disability risk in major occupations

Applying the regression model to individual-level data yields an estimate of the predicted risk for employees at a given point of time. This allows for building reports that highlight the variation and annual change in the predicted risk across a given employer's employee groups. Furthermore, the model allows for tentative evaluation of the cost of disability risk.

For example, Table 2 shows the estimated three-year risk of drawing a disability pension for employees at year-end 2021 across age and occupational groups. The total three-year risk of drawing a disability pension per employee is 1.82 per cent, but there is great variation between occupational groups as well as between age groups. As expected, the per-employee risk assessment increases with age. It is also noteworthy that in local government, many occupations are highly gendered, and age structures vary.

Combined with the estimated cost of individual disability pensions, the individual-level risk ratings provide a tool for approximating the impact of employees exiting the workforce on the grounds of disability on the employer's annual pension expenditure should some or all the predicted risks materialize. Also, the effect of changes in some of the risk factors can be estimated in concrete monetary terms.

Table 1. *Model estimates and statistics*

Predictor	Estimate	Std. Error	z value
Intercept	-7.6300***	0.0772	-98.80
Year	-0.2029***	0.0370	-5.49
Eligible for OA pension	-1.7960***	0.0482	-37.27
SA spell (60+ days): 1	0.5493***	0.0412	13.34
Previous DP: 1	1.6310***	0.0595	27.43
Gender: female	0.1154***	0.0231	4.99
Age 43–53 yrs.: 1	-0.6370***	0.0244	-26.12
Age	0.0599***	0.0016	37.00
Number of 60+ SA days	0.0113***	0.0008	14.51
SA spells (15–29 days)	0.7728***	0.0417	18.52
SA spells (30–44 days)	1.0750***	0.1508	7.13
SA spells (45–59 days)	1.5470***	0.0800	19.33
SA spells (60+ days)	2.1730***	0.1330	16.34
Year*Age	0.0023***	0.0007	3.24
SA spell (60+ days): 1*Years since 60+ SA spell	0.0082***	0.0186	0.44
Previous DP*Years since DP	-0.0621***	0.0126	-4.94
Gender: female*Number of 60+ SA days	-0.0009***	0.0009	-1.09
Gender: female*SA spells (15–29 days)	-0.1304***	0.0449	-2.90
Gender: female*SA spells (45–59 days)	-0.3267***	0.0878	-3.72
Gender: female*SA spells (60+ days)	-0.2385***	0.0742	-3.21
SA spells (0–4 days)*Age <31 yrs.: 0	-0.0936***	0.0182	-5.14
SA spells (0–4 days)*Age <31 yrs.: 1	0.0039***	0.0139	0.28
SA spells (0–4 days)*Age 43–53 yrs.: 1	0.0049***	0.0068	0.72
Age 43–53 yrs.: 1*SA spells (30–44 days)	0.1102***	0.0572	1.93
Age*SA spells (5–9 days)	0.0048***	0.0002	26.57
Age*SA spells (10–14 days)	0.0089***	0.0003	28.85
Age*SA spells (30–44 days)	-0.0040***	0.0029	-1.39
Age*SA spells (60+ days)	-0.0114***	0.0022	-5.13
Age*Occupation risk class	0.0021***	0.0001	24.25
Age*SA spells (0–4 days)*Employer SA duration distribution	0.0056***	0.0006	9.13

Notes: Significance levels: ***=1%, **=5%, *=10%; OA = old age; DP = disability pension; SA = sickness absence.
Source: Authors' elaboration.

Table 2. *Risk of disability pension by occupation (%)*

Occupation*	Aged 17 or older	Aged 55 or older
Nurses	1.96%	6.16%
Practical nurses	2.66%	8.73%
Upper secondary school teachers	0.92%	3.24%
Childcare workers	2.29%	7.40%
Social service nurses and counsellors	1.63%	5.76%
Experts in law, administration and economy	1.28%	3.30%
Construction, transportation and maintenance workers	1.99%	4.83%
Primary school teachers	1.72%	5.06%
Physicians	0.86%	3.07%
Office assistants and customer service workers	3.04%	6.70%
Elementary school teachers	1.03%	4.21%
Other nurses	2.21%	6.05%
Other workers	0.93%	3.16%
Hospital care assistants	3.35%	8.30%
Therapists in other healthcare	2.06%	6.08%
Social workers and other experts in social work	1.52%	3.93%
School assistants	1.85%	6.11%
Cleaning and kitchen workers	3.05%	7.13%
Firefighters and internal security officers	1.28%	5.08%
Experts in science and technology	1.69%	3.81%
Culture and art workers	0.87%	2.80%
Special teachers	1.44%	4.77%
Public health nurses	1.62%	4.83%
Other teaching experts	1.50%	3.48%
Library, museum and archives workers	2.06%	4.95%
Paramedics	1.19%	6.13%
Total	*1.82%*	*5.50%*

Note: *Modified classes based on ISCO-08.
Source: Authors' elaboration.

Critical duration of sickness absence days

In response to employers' demand for early indicators of diminishing work ability, Keva has proposed an indicator based on the duration of sickness absence days.

This indicator captures the underlying measures of individual working life and the above-mentioned risk factors. Based on our statistical modelling of individual cases, we suggest that there is a certain level of annual sickness absences that indicates a high risk of filing a disability pension application within three years. In this study, we refer to this number of days as the "critical duration".

After 60 consecutive sickness absence days, employees in Finland are required to obtain a medical assessment of their work ability. However, given the need to effectively identify employees at risk of work disability, most employers at present have policies in place for early work-ability intervention, where the frequency and number of sickness absence spells, combined with other information, are used by HR departments as guides for timing their interventions. However, the guidelines for the actual critical values used in this process are varied and usually based on expert opinion.

The research data allow us to model the critical duration of sickness absence days. Table 3 shows the indicator in major public-sector occupations; note that the Table shows the results for employees aged 45 or older with no previous disability pension application history and no long-term sickness absence spells (60 days or more) in a given year. Our second example of using risk assessment as a tool considers employees in the highest decile of the estimated three-year disability risk. In this example, observations for 2019–2021 are pooled to ensure that all occupations are sufficiently represented. These highest-risk deciles over three years account for 57 per cent of the total combined three-year risk estimate, but for only 8 per cent of the total number of employees. Our task is to identify the highest-risk group by examining the distribution of annual sickness absence days.

As the number of sickness absence days increases, the number of highest-risk employees in the remaining population decreases, but the share of these highest-risk cases increases. Assuming limited HR resources and the need to determine the level of annual sickness absence days so that both the number and the share of highest-risk employees crossing this threshold are maximized, the results for this critical value of annual sickness absence days in occupational groups are presented below. The differences between occupational groups highlight the variance in the impact of the factors representing the number of sickness absence days for the total risk in the prediction model.

Given that the award of a disability pension is very rare in the early life course, we focus on employees aged 45 or older. Also, employers should be aware that employees with a history of having claimed a disability pension or who have 60 sickness absence days annually have an elevated risk of disability. These employees are excluded from the analysis. Bearing these limitations in mind, and combined with other information about employees, employee-specific guidelines for critical sickness absence days can be used to optimize the timing of early interventions. Other similar approaches may be used with different trajectories of sickness absence days together with critical duration.

Table 3. *Critical duration of sickness absence days in major public-sector occupations in 2021*

Occupation**	Share of total*	Critical duration, days
Secondary school teachers	9%	18
Nurses	8%	20
Practical nurses	8%	12
Construction, transportation and maintenance workers	7%	16
Childcare workers	6%	14
Experts in law, administration and economy	6%	16
Office assistants and customer service workers	6%	8
Social service nurses and counsellors	5%	17
Primary school teachers	4%	20
Physicians	4%	19
Hospital care assistants	4%	8
Cleaning and kitchen workers	3%	9
Elementary school teachers	3%	20
Social workers and other experts in social work	3%	16
School assistants	2%	21
Special teachers	2%	20
Total	*100%*	*15*

Notes: *Aged 45 or older without long-term sickness or a disability pension background; **Modified classes based on ISCO-08; DP = disability pension.
Source: Authors' elaboration.

Table 3 shows that the average critical duration among the study participants is 15 days. We also see that there is notable variation between the major occupations. Those occupations with lower-than-average critical duration are of particular interest. In a range of social and health care occupations, the critical duration is low; examples include office assistants and customer service workers (8 days). There are also highly demanding physical occupations, such as hospital care assistants (8 days), cleaning and kitchen workers (9 days), and practical nurses (12 days).

These findings are unsurprising in the light of previous studies which show that these occupations are both physically and mentally strenuous. The added value of our work lies in the fact that the indicator we propose can be observed in daily occupational health care contexts.

Occupations with notably higher-than-average critical duration include nurses, pre-school teachers, and elementary school teachers (20 days). We assume that in

these large occupational groups, the connection between sickness absences and disability pensions is weaker than in occupations with lower critical duration; that is, there is an inherent base level of sickness absences below which no effect is seen on the risk of claiming disability pensions.

Costs of sickness absences: A case study of a major local government employer

Our case example is one of the largest local government employers in Finland, which has a diverse professional workforce. The largest occupational groups are in the fields of health care, education, social services, and childcare, together with administration and other support functions.

Applied to the case employees in 2021, the proposed prediction model for the risk of drawing a disability pension offers a snapshot of how the risk is distributed in different age and occupational groups and allows for comparisons with other similar employers. The model yields an estimate of 556 new disability pension awards over the next three years. The risk is most prominent in older age groups and occupations with the most pronounced stressors for disability. Occupational groups also differ in terms of age and gender. The risk estimates and some descriptive statistics are presented in Table 4.

In 2021, employees had almost 88,000 sickness absence spells. About 84 per cent of these spells were 1–5 days in duration, 15 per cent lasted 6–30 days, and 1.1 per cent lasted over 30 days. The total direct cost of sickness absences for that year was estimated at EUR 50 million, and the employer's disability pension payments totalled EUR 20.3 million. If the number of sickness absence spells decreased by 20 per cent, we can evaluate the effect on the estimated risk of drawing a disability pension and also get an approximation of how different costs would be affected, assuming no changes in other risk factors. Table 5 shows how the risk of drawing a disability pension, the direct costs of sickness absences, and cost of pension payments for the employer are affected.

The effect of sickness absence spells of different durations on the estimated disability pension rate varies between employee and age groups. The effect of short spells (1–5 days) is usually smaller than that of longer spells, and younger employees' sickness absence spells also have the least effect on the risk of drawing a disability pension. There are some occupational groups in which we see a strong connection between sickness absence spells and the risk of drawing a disability pension, such as practical nurses younger than age 45 with sickness absence spells longer than 6 days. In contrast, the connection is weak for upper secondary school teachers, where only sickness absence spells of more than 30 days for employees older than age 60 have a stronger connection to the risk of drawing a disability pension.

Table 4. *Disability risk, critical duration of sickness absence days, and descriptive statistics*

Occupation*	DP risk	Mean age, years	Mean SA, days	Share of women	Critical duration, days
Practical nurses	1.7%	41.4	13.8	85%	17
Upper secondary school teachers	0.9%	45.4	5.2	72%	18
Social service nurses and counsellors	1.3%	42.4	11.3	80%	23
Childcare workers	1.7%	42.1	16.5	93%	18
Construction, transportation and maintenance workers	1.6%	45.3	9.7	26%	22
Experts in law, administration and economy	1.2%	46.3	4.8	68%	20
Primary school teachers	1.2%	42.4	14.0	95%	26
Nurses	1.4%	42.5	12.3	86%	22
Elementary school teachers	0.6%	41.3	9.2	79%	20
Office assistants and customer service workers	2.1%	47.6	10.3	87%	14
Social workers and other experts in social work	1.1%	44.2	6.5	88%	23
Cleaning and kitchen workers	2.5%	47.3	11.7	80%	14
Physicians	0.8%	41.3	5.1	74%	21
Other nurses	2.1%	45.8	12.5	87%	17
Public health nurses	1.1%	40.6	11.5	99%	18
Experts in science and technology	1.3%	47.2	5.3	42%	19
Special teachers	1.1%	45.1	10.4	85%	23
Therapists in other healthcare	1.2%	42.3	8.9	83%	20
School assistants	1.4%	42.5	14.2	80%	25
Firefighters and internal security officers	1.6%	41.6	15.0	9%	22
Library, museum and archives workers	1.7%	47.4	9.6	67%	17
Other teaching experts	1.2%	48.2	5.0	73%	22
Other workers	1.2%	44.5	4.6	46%	21
Culture and art workers	1.0%	44.1	4.8	54%	32
Hospital care assistants	1.3%	46.3	6.5	75%	17
Paramedics	0.5%	38.5	7.6	32%	25
Total	*1.4%*	*43.8*	*10.3*	*75%*	*19*

Notes: *Modified classes based on ISCO-08; DP = disability pension; SA = sickness absence.
Source: Authors' elaboration.

Table 5. *Estimated effect of a 20 per cent decrease in the number of sickness absence spells*

	1–5 days	6–30 days	Over 30 days
DP risk	-3.80%	-5.50%	-4.20%
Number of new DP retirees in three years	-21	-30	-23
Direct cost of SA spells (millions of EUR)	-3.5	-2.5	-0.4
Employer pension payments (millions of EUR)	-1.3	-1.8	-1.4

Notes: The day intervals for sickness absence spells follow Keva's already established digital services; DP = disability pension; SA = sickness absence.
Source: Authors' elaboration.

The critical duration for different occupations was also presented in Table 4. For all employees aged 45 or older, the critical duration is 19 days, somewhat higher than the public sector total (cf. 14 days in Table 3). Comparing major occupation groups, the critical duration ranges from 14 days (cleaning and kitchen workers, office assistants, and customer service workers) to 32 days (culture and art workers). The occupations with the lowest critical durations are also among those, on average, with the oldest employees. For some professions, the mean number of annual sickness absence days (not presented for those aged 45 or older) is very close to the critical duration for childcare workers, cleaning and kitchen workers, and practical nurses, for example. Employers should devote more attention to these occupations, especially as the predicted risk is also among the highest in these professions.

Modelling and employer customer services

All private and public providers of Finland's statutory earnings-related pensions continue to develop and improve digital services for their employer-customers, especially in relation to the provision of disability pensions. The key aim of these services is to prevent permanent disability, for example by providing practical work ability services. Digital services include tools for evaluating the significance of sickness absences and their costs.

As the sole provider of public-sector pensions in Finland, Keva has a key role to play in improving and developing those services. With 1,940 employer-customers in central and local government, one of Keva's roles is to develop and promote digital services for public-sector employers with different levels of HR resources.[5]

5. The role of design thinking and agile methodologies in the digitalization of public services with the aim to improve the performance of government is covered is an extensive literature (e.g. World Bank, 2022; Welby and Tan, 2022; see also ISSA, 2019).

The modelling framework presented in this article represents a new step in the process of establishing and delivering a concrete tool for analysing the risk of drawing disability pensions and the costs for public-sector employers. Keva has already made good headway in using the model estimates to deliver several employer-specific indicators via Power BI visualization tools. The employers who have provided the necessary sickness absence information find the new tool useful and are committed to continue providing this information in future.

Conclusion

In this article we have presented an overview of our modelling experiences in predicting future cases of workers leaving employment prior to the retirement age to receive a disability pension. The modelling exercise stems from Keva's statutory task to minimize new awards of disability pensions and to introduce digital tools for use by its employer-customers.

The research data and study design allowed us to examine sickness absence spells of all durations, which is a clear advantage in modelling disability risk. The modelling yields two major outcomes: estimates for occupation-specific risk for drawing a disability pension and the critical duration of sickness absence spells, which gives advance warning of an increased risk for employees in a given occupation leaving employment prior to the retirement age to receive a disability pension. Knowledge of occupational differences in sickness absences represents valuable information for HR experts and occupational health care services. It is equally important to differentiate between sickness absence spells that are associated with elevated work-disability risk and those that are not (e.g. seasonal flu-related sickness absences).

Regarding our first principal research question, it is important that employers pay attention to sickness absences in certain occupations, given the socioeconomic information held about employees. These results are in line with the findings of Bethge, Spanier and Streibelt (2021). According to our results, the occupations with the highest risk (at midlife) for drawing a disability pension were the more physically demanding jobs. Critical duration indicates that 15 sickness absence days per year is the limit above which the risk of leaving employment prior to the retirement age to receive a disability pension increases significantly, but in some occupations the limit is clearly lower.

The generalizability of the modelling results is an issue of key importance. Keva already provides tools, for example, for employers to calculate occupational health care costs. Employers obviously vary in size and therefore so do the implications of predictions of employees work ability on their finances. Most large employers have detailed up-to-date information on their sickness absence costs, whereas small employers, given their limited resources, have fewer opportunities to initiate new

practices and to compile such information. It is important to note that the data we used in developing the proposed digital tool does not include information for small employers and, therefore, the results must be applied with caution.

The tools currently in use provide employers with useful and consistent information as well as support for practical decisions in the workplace. The tool developed here has attracted attention and interest among employers, and not just among those that provided the necessary data. As regards our second principal research question, modelling the given data using the proposed statistical model yielded the parameters needed for the digital tools that are relevant in practical risk management.

As a general note, earlier studies have indicated that employers can benefit from investments in work disability management, for example by targeting management actions on the principal work disability risks (e.g. Leino et al., 2023; Reiman et al., 2017). Many of the possible problems in corporate wellness can be solved in situ at the workplace, for instance by improving strategic work ability management and anticipating health problems among employees (e.g. Anttilainen et al., 2023). Beyond occupation-specific risks and the critical duration indicator, our case example and its approximation of the costs is highly policy relevant as it yields a concrete financial measure of sickness absences. The cost approximation is also available for other public-sector employers.

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Appendix

Table A1. *Research data contents*

Explaining variable	Description
Occupation risk class	Relative risk class of the person's occupation on a scale of 1–10. In detail, the occupations are based on ISCO-08 classification, which is fine-tuned for Finnish public sector employees
Eligible for OA pension	Value indicating if the person is soon eligible for old-age pension (0=not eligible within the following three subsequent calendar years, 1/3=eligible in the third subsequent calendar year, 2/3=eligible in the second subsequent calendar year, 1=eligible in next calendar year)
Age <31	Value indicating whether the integer part of the person's age at the end of the year of the observation is less than or equal to 30
Age 43–53	Value indicating whether the integer part of the person's age at the end of the year of the observation is greater than or equal to 43 and less than or equal to 53
Age	Integer part of the person's age at the end of the year of the observation
SA spells (0–4 days)	Number of distinct continuous SA spells (concatenated if consecutive and started on the year of the observation) of length of at most 4 days
SA spells (5–9 days)	Number of distinct continuous SA spells (concatenated if consecutive and started on the same calendar year) of length of at least 5 days and at most 9 days
SA spells (10–14 days)	Number of distinct continuous SA spells (concatenated if consecutive and started on the same calendar year) of length of at least 10 days and at most 14 days
SA spells (15–29 days)	Number of distinct continuous SA spells (concatenated if consecutive and started on the same calendar year) of length of at least 15 days and at most 29 days
SA spells (30–44 days)	Number of distinct continuous SA spells (concatenated if consecutive and started on the same calendar year) of length of at least 30 days and at most 44 days
SA spells (45–59 days)	Number of distinct continuous SA spells (concatenated if consecutive and started on the same calendar year) of length of at least 45 days and at most 59 days
SA spells (60+ days)	Number of distinct continuous SA spells (concatenated if consecutive and started on the same calendar year) of length of at least 60 days
SA spell (60+ days)	Whether the person is known to have been on a continuous SA spell of at least 60 days during any of the preceding calendar years (0/1)
Previous DP	Whether the person has received disability pension at any time before the end of the year (0/1)
Number of 60+ SA days	How many days beyond the 60th day the longest continuous SA spell that started on the year of the observation lasted

(Continued)

Table A1. *Research data contents* - Continued

Explaining variable	Description
Gender	Gender of the person (M=male, N=female)
Years since 60+ SA spell	How many years since the last preceding calendar year that the person was known to have been on a continuous SA spell for at least 60 days (consecutive SA spells were concatenated if they started on the same calendar year)
Employer SA duration distribution	Gini coefficient for the distribution of sick leave lengths reported by the persons principal employer during the year of observation
Years since SA	How many calendar years has there been from the last disability pension payments (0=last payment during the year of observation, 1=last payment during the preceding calendar year, …,10=last payment on the 10th preceding calendar year or earlier)
Year	Calendar year counter for the observation, 1=2016, 2=2017, etc.

Source: Authors' elaboration.

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