Assessing the impact of health status on future sickness absence and work functioning after return to work: multimorbidity in working populations

Mònica Ubalde López

TESI DOCTORAL UPF / 2016

DIRECTORS DE LA TESI

Dr. George Delclós Clanchet (Center for Research in Occupational Health, Department of Experimental and Health Sciences, Universitat Pompeu Fabra; Southwest Center for Occupational and Environmental Health, Department of Epidemiology, Human Genetics, and Environmental Sciences, The University of Texas Health Science Center at Houston School of Public Health)

Dr. David Gimeno Ruiz de Porras (Center for Research in Occupational Health, Department of Experimental and Health Sciences, Universitat Pompeu Fabra; Southwest Center for Occupational and Environmental Health, Department of Epidemiology, Human Genetics, and Environmental Sciences, The University of Texas Health Science Center at Houston School of Public Health, San Antonio Campus)

DEPARTAMENT DE CIÈNCIES EXPERIMENTALS I DE LA SALUT

Als meus pares
que m´han regalat la vida,
i al amor dels tres Èssers
que li donen sentit

Como cajas vacías
apiladas las unas
encima de las otras
en frágil equilibrio.
Vikram Babu pregunta:
¿eres así?

~ Jesús Aguado

To be great, be whole;
exclude nothing, exaggerate nothing that is not you.
Be whole in everything. Put all you are
into the smallest thing you do.
So, in each lake, the moon shines with splendor
because it blooms up above.

~ Fernando Pessoa

AGRAÏMENTS

Acknowledgements

I finalment aquest moment arriba, i les sensacions són intenses i contradictòries. Una barreja de satisfacció i cansament, d´orgull present i nostàlgia, d'alliberament però d'incertesa, de felicitat i a la vegada certa tristor. El camí ha estat llarg, intens, de vegades dur i d´altres decebedor, però en conjunt enriquidor, motivador i sobretot apassionant. I quan hom, com jo, se sent afortunada d´haver trobat pel camí tantes persones que m´han ajudat a ser qui sóc, com sóc i el que sóc, no puc fer res més que agrair-ho.

Gràcies als bons moments, però també als no tant bons, als complicats, als decebedors, als de desànim, de soledat, els de silenci sense resposta, a les crisis i les angoixes. Aquells moments que et fan parar, pensar, canviar quelcom i créixer.

Papá, mamá gracias por cuidarme, por cuidarnos, por darme aliento y confiar siempre em mi. Gracias por enseñarme que el esfuerzo, el tesón y el trabajo duro desde la ilusión y la humildad tiene su recompensa. Por ayudarnos a conciliar este loco ritmo de vida laboral y familiar siempre que hace falta y por vuestro amor. Sandra, Albert, gracias por aguantar mis discursos, mis broncas, mis enfados·····me tocó ser la mayor.

Gracias por mantener apretada la piña. No somos perfect@s pero cómo nos queremos.

Gracias Lidia i Jaime Juan, por ser esos segundos padres y geniales abuelos, siempre dispuestos, generosos que dan todo y más, y que siempre están pendientes del bienestar del resto.

Jaime, la integridad, la honestidad, la generosidad, eres un ser humano auténtico y uno de mis pilares. Llevamos más de media vida compartida y juntos hemos conseguido el proyecto más importante, el que más la llena y le da sentido. Siempre estas ahí, apoyándome, respetándome, entendiéndome y creyendo en mí incondicionalmente. Gracias por amarnos tanto. Testim. Menai, Nahia gràcies per arribar a les nostres vides, pel vostre somriure, les vostres rialles, pels "achuchi mami", pels dibuixos, les cançons, els balls, pels petons de bona nit, les abraçades tendres, per la vostres ganes de viure, per adonar-vos dels moments durs i cuidar-nos. Gràcies per donar-me el privilegi de ser la vostra mare.

Gràcies als qui m´heu acompanyat en aquest viratge professional, que vaig emprendre fa sis anys, quan vaig decidir deixar-ho tot per dedicar-me a quelcom que m´apassiona: fer recerca.
Fernando, todo empezó en un coffee break durante unas jornades de salud laboral en el campus mar, ¿recuerdas?. Gracias por abrirme las puertas al mundo de la

epidemiología laboral y la salud pública, por tu tesón y por transmitir tu pasión por la investigación·

Jordi, David, nois "great minds think alike"· Fem un bon equip i d´aquí el resultat· Gràcies per aquesta empenta final· David, "el que fila prim"· M´emporto de tu la facilitat per la paraula escrita, el teu sentit pragmàtic, el teu marcat esperit crític i la meticulositat (sovint el revisor que t´agradaria escanyar)· Gràcies per ajudar-me a entendre una mica més d´Stata, per l´empenta que li vam donar a aquesta tesi als inicis a San Antonio, per la bona feina feta durant aquests anys i pels bons moments· Jordi, una de les troballes d´aquesta marató· Zen Master, el "little grasshopper" s'emporta moltíssim de tu· Ha estat una immensa sort poder treballar al teu costat, tenir la teva guia i el teu suport com a mentor· Gràcies per deixar-me conèixe´t de més aprop, per la teva saviesa, la teva humilitat, per la teva mirada oberta i generosa, per ser *tant* honest i íntegre· Fas que el difícil sembli fàcil i això es molt d'agrair· Gràcies a tu i a la Conxita per acollir-me com a una filla més durant la meva estada Houston· No penso perdre´t de vista, Sir !!

Ute, thanks for your warm hosting, friendship, continuous support and care during my short stay in the "cold but cosy" Groningen· I really enjoyed the three months I lived in between the boat and the UMCG· It is always a pleasure to work closely with you· Iris, I really appreciate your generosity during the first period of my

stay at Groningen that summer: my experience would not have been the same without a bike and a sweet home· Hope I watered your plants properly·

María, gracias por la ayuda, el cariño, el apoyo, las conversaciones, los cuidados y los abrazos (que son gratis!!)· Sandra, gràcies per ser com ets, sempre disposada a ajudar (remugant de tant en quant això sí, bruixa!), gràcies per escoltar-me, per passar-ho be juntes, anar de mercadillos, compartir experiències amb el handcraft i per acompanyar-me en aquestes últimes setmanes ocupant-te de treure´m de la biblioteca per anar a dinar· Andree, Cynthia, Clara, chicas gracias por ser cómplices, amigas y compañeras· Por compartir confidencias, cenas, comidas, cañas, tapas, voley, coral, ioga, running, aquel viaje regado de glühwein, congresos, dudas y discusiones sobre hipótesis, métodos, resultados y discusión· He aprendido mucho con y de vosotras· Dinora, la única y singular, mi hermana panameña, una de las mujeres más fuertes que he conocido, la que llega más tarde siempre a todo y a la que adoro· Cuánto me hiciste sufrir con la vaina del depósito de tu tesis Dra Bernal !!!· Montse, la resistència ,sempre "aguantando el chaparrón", gràcies pel teu suport administratiu i personal· Et desitjo molta pau i felicitat·
A tod@s mis compañer@s del CISAL, l@s que estuvieron y l@s que siguen: Mireia, Sergio, Xavi, Pamela, Laura, Albert, Consol, Josep María, Javier, José Miguel, Emily,

Marianela, Elena, Isabel, José Mª, Bàrbara· De cada un@ guardo un pedacito·

Alessa, eres una persona muy linda, por dentro y por fuera, gracias por tu continua gratitud y tus ganas de compartir· Por guiarme en la práctica de una filosofía de vida que nos ayuda a estar y ser mejores· Es un tesoro conocerte·

A la mar, la Mediterrània, la de la meva ciutat i la de es meu racó d´es món, que tanta serenor i tranquil·litat em regala i tant s´emporta quan ho necessito·

A la meva "altre família", la barceloneta rumbera, el somorrostro power, les walking girls i la resta d´estimats/ades, pels cangurs i recollides del cole improvisats, pels sopars espontanis, els cine forums gastronòmics, els aperitius, les canyes amb teràpia de grup, les vacances en família, les escapades de cap de setmana per desconectar· Jesús, gracias por regalarme tu sensibilidad y prestarme tu poesia· Laura i Josep, gràcies per donar-li personalitat a la coberta, per fer-la més meva amb la vostra creativitat· Gràcies, estimats/des per les tertúlies que obren alguns matins davant d´un cafè , i per les rondes de birres acompanyades amb pretzels calents i pa àrab per celebrar el final de la setmana els divendres al Convent· Auf weg die chaise!!!

Mò

Abstract

Background: Research on multimorbidity, the co-occurrence of two or more health-related conditions, has mainly focused on chronic and common diseases in patient and older populations. The prevalence of multimorbidity in workers and its effect on occupationally relevant outcomes is poorly known. **Methods:** We computed baseline multimorbidity scores using severity-weighted chronic conditions based on: 1) the relationship between chronic conditions, health-related behaviors and symptoms, and 2) their individual influence on poor health status. Next, we assessed the longitudinal effect of multimorbidity on the incidence and duration of overall and diagnosis-specific sickness absence, as well as on work functioning after return to work from a sickness absence episode. **Results:** Among men, higher baseline multimorbidity was a risk factor for overall incident sickness absence and episodes due to musculoskeletal and cardiovascular diseases. In women, the trend was less evident, although mental disorders had the strongest association. Associations with sickness absence duration were less consistent. Higher multimorbidity negatively impacted work functioning over time. **Conclusion:** Multimorbidity affects occupational outcomes, such as sickness absence, and its measurement may allow the early detection of workers coping with unbalanced health-related limitations and work demands.

Keywords: Multimorbidity; multimorbidity patterns; chronic health conditions; health-related behaviors; symptoms; longitudinal; occupational health; sickness absence; sick leave; work functioning; job performance; musculoskeletal disorder; cardiovascular disease; mental health disorder.

Resum

Antecedents: La recerca sobre multimorbiditat, la coexistència de dues o meés condicions relacionades amb la salut, s'ha enfocat principalment a poblacions de pacients i de major edat. La prevalença de multimorbilitat entre treballadors, i el seu efectes sobre indicadors rellevants per a la salut ocupacional, no està gaire estudiada. **Mètodes:** Partint de dades de dues poblacions treballadores, vam calcular puntuacions de multimorbilitat ponderades per la seva severitat considerant: 1) la interrelació entre condicions cròniques, hàbits relacionats amb la salut i símptomes, 2) l'efecte de cada condició crònica sobre el mal estat de salut general. Seguidament, vam avaluar l'efecte longitudinal de la multimobilitat basal en la incidència i durada del total d'episodis d'incapacitat temporal, d'episodis per diagnòstics específics, així com en la capacitat d'assolir les demandes laborals un cop retornat d'una incapacitat temporal. **Resultats:** Pels homes, la multimorbiditat alta va ser un factor de risc tant pel total d'episodis d'incapacitat temporal com per aquells deguts a trastorns musculoesquelètics i malalties cardiovasculars. Per a les dones aquesta tendència va ser menys clara, malgrat que els episodis deguts a trastorns mentals van mostrar l'associació més evident. L'associació amb la durada dels episodis va ser menys consistent. La multimorbilitat alta es va associar negativament a la capacitat per assolir les demandes laborals, al llarg del temps, i un cop tornat al treball després d'una incapacitat temporal. **Conclusió:** La multimorbiditat té efectes sobre indicadors de salut laboral. Mesurar-la permetria la detecció precoç de treballadors que s'enfronten a un desequilibri entre les limitacions relacionades amb la salut i les

demandes laborals, i que estan a risc d'un episodi d'incapacitat temporal. **Paraules clau:** Multimorbilitat; patrons de multimorbilitat; condicions cròniques de salut: hàbits relacionats amb la salut; símptomes; longitudinal; salut laboral; salut ocupacional; incapacitat temporal; demandes laborals; rendiment laboral; trastorns musculoesquelètics; malaltia cardiovascular; trastorns mental.

Foreword

Over the last several decades, improvements in public health policy, together with advances in clinical care, have contributed to longer life expectancy. In addition to a continuous decrease in birth rates, this situation has led to a greater population aging. The workforce, presumably younger and healthier than the general and patient population, is also aging. Populations are living longer but working longer due increases in retirement age and a slowdown in the inflow of younger workers. The resulting increase in chronic conditions linked to aging produces a great impact that challenges governments, social security and health systems, and society in terms of expenditures, both social and economic.

Multimorbidity is defined as the co-existence of two or more chronic conditions with none considered as the index condition. Its prevalence and patterns have usually been studied in patients and older populations because of their high prevalence of chronic conditions, but less is known about multimorbidity in younger populations. Although the prevalence of multimorbidity increases with age, it is not absent in younger, presumably healthier groups, such as the working population, and merits consideration in terms of prevention and health surveillance. Research on multimorbidity emphasizes a holistic approach that examines patterns, rather than a disease-centered approach, thus considering a broader context of influences on the burden of illness.

Co-existing chronic conditions represent not only the major cause of mortality worldwide and disability, but also impact outcomes relevant to occupational health, such as work ability, work functioning and sickness absence. Although many workers cope well with multimorbidity, others struggle to meet work demands and are at risk of absence due to health limitations.

This doctoral thesis uses a novel approach to measuring multimorbidity and estimating its burden and distribution in working populations by constructing comprehensive, multidimensional multimorbidity scores for use as a predictor of population-based health-related outcomes. As a second goal it examines whether multimorbidity affects outcomes relevant to occupational health research and practice, particularly sickness absence and work functioning after return to work, and to what extent.

The body of this dissertation consists of three research papers. The first one has already been published in *International Archives of Occupational and Environmental Health*; as of this writing, the other two are undergoing minor revisions before final resubmission to *Occupational Medicine* and the *Journal of Occupational Rehabilitation*. Results related to these papers have been presented at an international scientific seminar, and as oral presentations in several national and international research conferences in the fields of occupational epidemiology and public health.

The research underpinnings of this doctoral thesis were conducted at the Center for Research in Occupational Health (CiSAL) at Universitat Pompeu Fabra in Barcelona, The University of Texas School of Public Health at Houston and San Antonio campuses (USA), and at The University Medical Center Groningen (The Netherlands). It was supported in part through a collaborative agreement between Corporación Mutua and the CiSAL, by the Plan Estatal de I+D+i 2013-2016, ISCIII-Subdirección General de Evaluación, Fomento de la Investigación (Grant PI 13/00749) and FEDER, by discretionary funds from The University of Texas School of Public Health, under a joint Letter of Agreement between Pompeu Fabra University and The University of Texas, and by the CIBER of Epidemiology and Public Health of Spain (CIBERESP).

List of contents

List of figures

Page

1

General Introduction

As you start to walk on the way, the way appears

~ Rumi

1 GENERAL INTRODUCTION

1.1 Challenges facing an aging workforce

1.1.1 Demographic changes: population aging

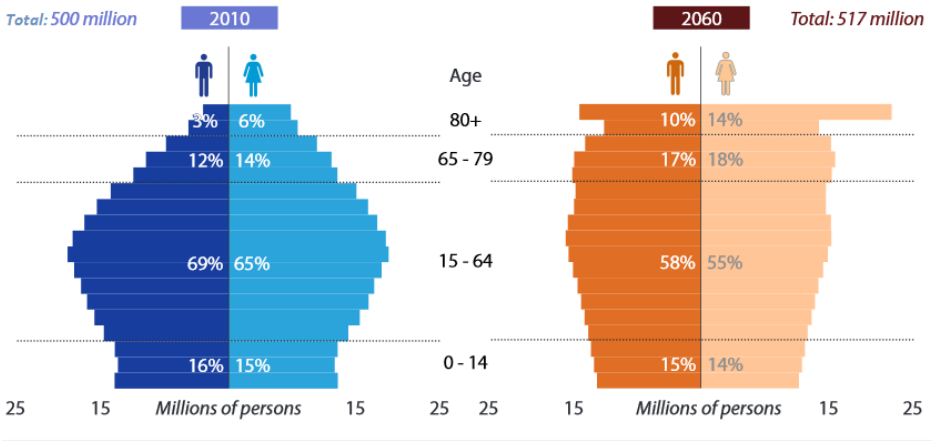
Over the last two decades the mean age of the general population has been increasing. As a result of declines in fertility and mortality, and a greater life expectancy, the proportion of people aged over 60 years is continuously growing in nearly all developed and developing countries. It is expected that by 2050 people 60 years of age and over will represent 21% of the world population (2 billion people), even exceeding the number of children (UN, 2013; WHO, 2015).

This increase is changing the shape of population demographics in developed countries, from pyramids to columns, and in some cases even inverting them (Figure 1). In the European Union (EU) this is expected to result in an increase of 9 years in the median age by 2060 (Figure 2). By then, one out of every three persons in the EU will be 60 years of age or older (Sabbati, 2013).

On one hand, this can be considered a success, reflecting advances in clinical care and public health policies. On the other, this population aging poses a great challenge for society, health systems and governments in terms of promotion, prevention, healthcare and future

health policies, together with major social and economic consequences.

Figure 1. Distribution of the EU27 population by age and sex from 2010 to 2060.

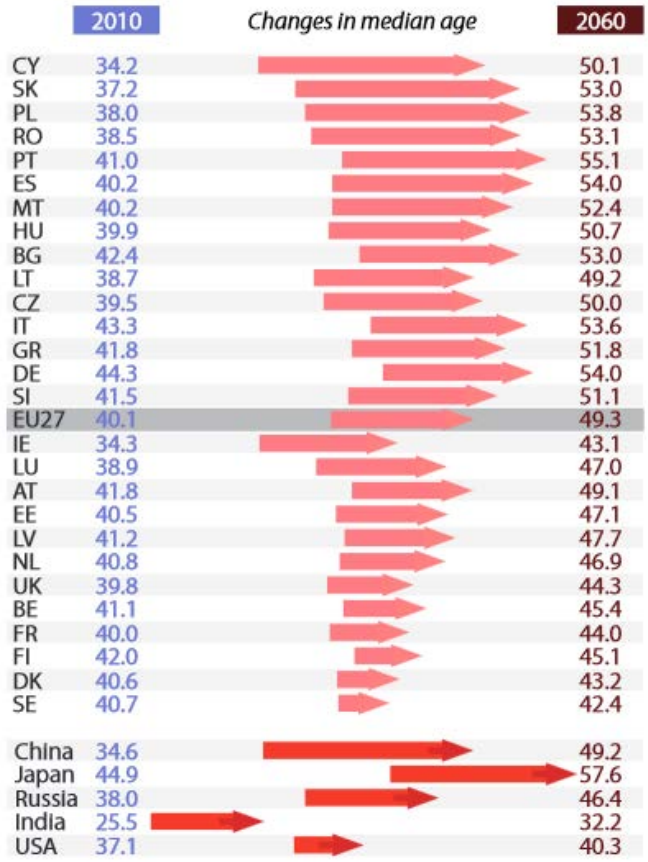


Source: European Parliamentary Research Service Blog.
Data source: Eurostat.

According to the European Parliamentary Research Service, expenditures in healthcare and long-term care will increase from 7% and 2% to 9% and 3%, respectively, by 2060 in the EU (Figure 2) (Sabbati, 2013).

Although population aging takes place in nearly all countries, projections point to a concentration of older persons in the less developed regions, since growth is faster there, and these countries are expected to house nearly 80% of the world's population age 60 and over by 2050.

Figure 2. World population median age (years) changes by countries from 2010 to 2060.



Source: European Parliamentary Research Service Blog.
Data source: United Nations. Population Division.

Nevertheless, after Japan, Europe remains the world area most affected by aging, with Italy being the country with the largest proportion of people age 60 and over (32% and 27% in 2013 respectively (UN, 2013).

Policies promoting well-being and facilitating participation of older population should be a priority for society and governments by providing empowered environments to prevent and better manage health and disability over a more sustainable lifespan.

1.1.2 The aging workforce: new needs for labor markets, social security, health care systems and companies.

The size and composition of the future labor force is being jeopardized by the impact of population aging. While we live longer as a result of advances in clinical care and public health policies, we are also working longer due to increases in the retirement age. In addition, the inflow of the youngest labor force has faced a delay and continuous slow down over the last decades (ILO, 2014).

This trend has led to a large increase in the proportion of older workers in most countries in the Organization for Economic Cooperation and Development (OECD, 2015). Together with a deceleration in labor force growth, this poses a great challenge to labor markets, companies, human resources, and health care systems as well as to the foundations of welfare states, primarily social security systems, responsible for financing disability benefit and pension programs. In many European countries, social and economic development are at risk due to the strain produced by displacement from the labor market related to health limitations, especially among older workers.

The need to adapt labor markets to such sharply increasing age projections in the coming decades has no historical precedent. The sustainability of pension schemes is under threat by a shift in the percentage of economically productive (ages 16 to 64 years) and the older dependent population (age 65 and over). EU27 projections of old-age support ratio [population age 65+/population age 15-64] suggest that by 2060 there will only be two persons working for each person age 65 and over, compared to four people in 2010 (Sabbati, 2013). In the coming decades, a continuous decline of this ratio is expected in both developed and developing countries.

Given the scenario of losing their jobs, older workers exhibit higher rates of long-term unemployment and involuntary economic losses, once they find a new job. This is due to being more likely to be re-employed in part-time, temporary jobs and working fewer hours on average than before unemployment (Couch and Placzek 2010; Quintini and Venn 2013). Social security systems should provide social protections in terms of health care and cash benefits when facing unemployment, maternity, sickness and disability periods or retirement. When social protections are limited, as in some low and middle-income countries, individual spending may finance these situations. This condition, together with pressure to support an older population, will likely result in especially high levels of poverty among older persons (United Nations 2013).

In this scenario, policies focused on providing income security and gearing early retirement trends towards retaining older workers in the labor market , while increasing their employability, must be included in pension and social security programs (Börsch-Supan *et al.,* 2015). Further, national government policies should focus on stimulating labor force participation, lengthening the working lifespan.

These public and private measures should underpin the commitment of companies and employers to encourage healthy, sustainable and productive workplaces by accommodating aging workers who develop longstanding health limitations, such as those with chronic conditions. In this sense, the relation between aging and work as a whole implies individual and shared responsibilities that involve society and organizations, if these workers are willing to remain active (Ilmarinen, 2001b). However, the materialization of an individual´s work participation is a major responsibility of companies that should overcome age barriers in employment by the adoption of good and well evaluated practices (Walker & Taylor, 1998), in line with international recommendations (WHO, 1993). Adjusting the work environment, providing continuous education and training of older workers, and adapting social security systems to accommodate longer working lives are the main challenges for the Europe 2020 employment strategy (European Commission, 2012).

Finally, health care systems are not immune from these new needs and challenges. To meet the healthcare demands of the increasing burden of long-term health problems, countries must accordingly adapt and

update their health systems. Healthcare systems are largely based on the "acute care" or "medical" model, where individual disease treatment is the centerpiece, but this is no longer efficient when confronted with the increase in chronic disease burden. Overuse of primary care and emergency room visits, excess of medicalization and high hospitalization rates result in increasing expenditures but do not significantly improve population health (Wagner,2000; Greß, 2009).

The management of outcomes related to chronic conditions needs to be improved through a holistic patient-centered approach, and by the design and implementation of innovative and creative care programs (e.g., disease and behavioral self-management programs)(WHO, 2002).

1.2 Chronic conditions

As the world's population ages, the prevalence of single and multiple chronic health-related conditions is increasing (Fortin *et al.,* 2007), and this trend is expected to continue, along with related expenditures in public and private sectors. This situation translates into a large health and economic burden, with great socioeconomic impact, in both low and middle-income countries.

According to the 2002 WHO global report "Innovative care for chronic conditions: Building blocks for action", the spectrum of chronic conditions encompasses non-communicable conditions, persistent communicable conditions (e.g., HIV/AIDS), long-term

mental disorders and ongoing physical/structural impairments (WHO, 2002).

Chronic conditions represent not only the foremost cause of disability and mortality worldwide (6 out of 10 deaths globally), but also dominate the increasing global burden of disease (Mathers *et.al*, 2008). It is expected that by 2020 chronic conditions will be responsible for almost 80% of the global burden of disease in developing countries. Further, one in four EU adults reports having at least one long-lasting condition that limits their daily activities. Chronic diseases affecting at least 50 out of 100,000 people, known as "major chronic diseases" (MCDs), include cardiovascular disease, cancer, mental health problems, diabetes mellitus, chronic respiratory diseases and musculoskeletal disorders among others.

Collectively, MCDs account for almost 90% of EU mortality. In all regions of the world, the majority of incident chronic conditions are explained by the conjunction of main modifiable (i.e., health-related behaviors: physical inactivity, tobacco use, drinking and unhealthy diet), and non-modifiable risk factors (i.e., age and heredity); some infectious agents, environmental and psychosocial factors also account for a small proportion of disease.

The development of chronic diseases is also determined by underlying inequalities generated due to the role that social, cultural and environmental determinants play in affecting their prevention and control, as well as in intensifying their burden. In this sense, poverty is

a powerful cause for chronic diseases, and vice versa. Due to a higher exposure to risk and lower access to health services, the poorest are more vulnerable within this vicious cycle.

1.2.1 Multimorbidity: definition, measurement and prevalence estimates

The continuous increase in coexisting health conditions and unhealthy behaviors affects not only quality of life and mortality rates, but also ability to work, employability and disability (Robson, 2001; Fortin *et al.,* 2004; Bevan *et al.,* 2009). The coexistence of two or more health conditions has been, for some time, referred to indistinctly as *comorbidity*, i.e., the occurrence of any additional condition affecting the course and treatment of a primary condition (Feinstein, 1970; Valderas *et al.,* 2009), or *multimorbidity*, i.e., the occurrence of two or more chronic conditions with none considered the primary condition (van den Akker *et al.,* 1996).

Regarding its measurement, uniformity in the operationalization of multimorbidity is lacking (Fortin *et al.,* 2012a). There is great heterogeneity both in the selection (i.e., frequently, chronic conditions are selected based on the highest prevalence and/or mortality rates in the study population (Diederichs *et al.,* 2011) which varies by default) and number (i.e., coexisting diseases may simply be counted, ranging from six to over 100) of chronic conditions chosen (Huntley *et al.,* 2012). In addition, multimorbidity indices are typically based on the prevalence of selected health conditions in a specific population, on a

specific index-outcome relation, such as mortality (e.g., Charlson Comorbidity Index), hospitalization indices (e.g., Chronic Diseases Score) or physical impairment (e.g., Functional Comorbidity Index). As such, these standardized indices may facilitate comparability but, despite being useful for the specific outcome they are designed to capture, are of limited use to reflect the effect of multimorbidity on a given population as a whole, by disregarding the potential impact of multimorbidity on other target outcomes. In this sense, studies on multimorbidity prevalence have been based on populations where co-existence of two or more health conditions is reasonably expected (e.g., hospital and primary care patients, aged 50 years or over and older populations aged 65 years and older).

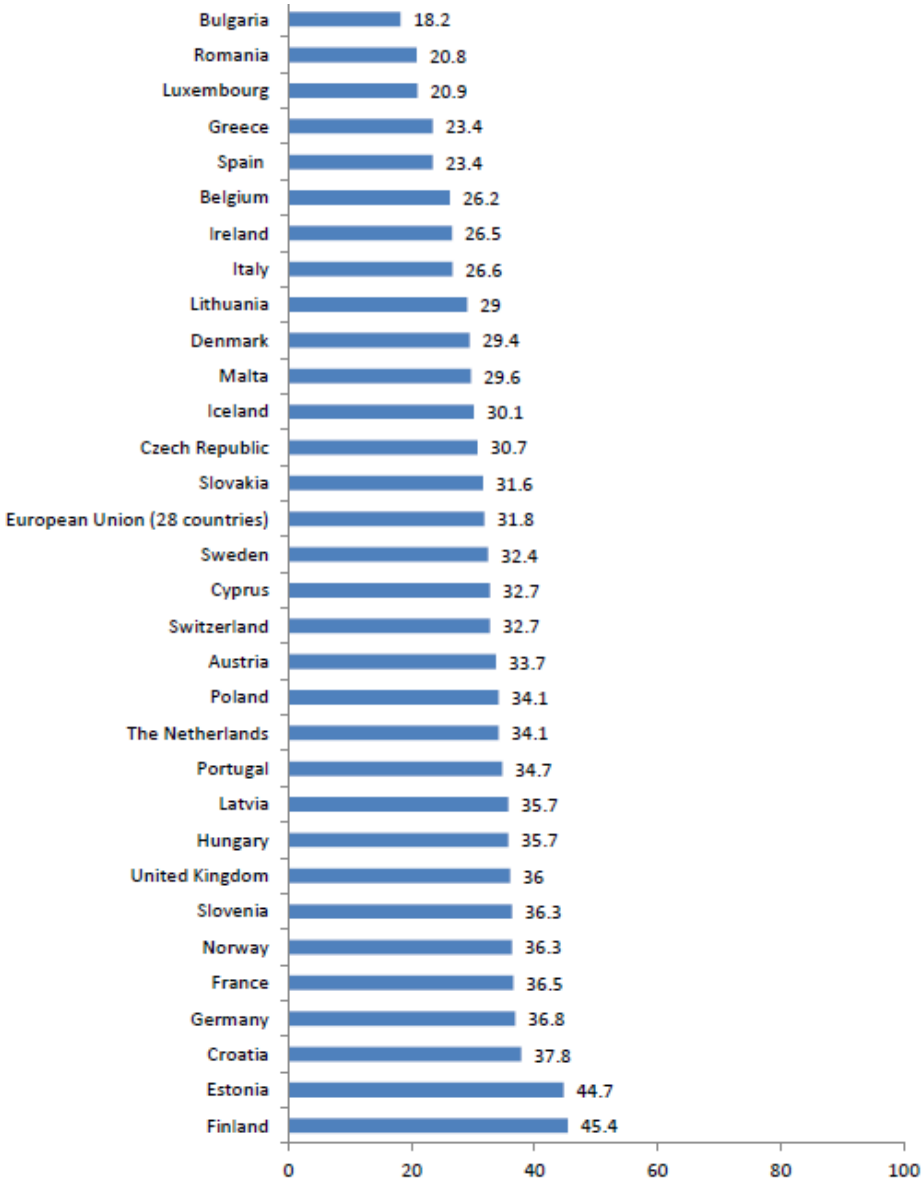
Measuring multimorbidity is key to describing its distribution among populations and assessing its impact on health indicators, but estimates of multimorbidity prevalence are affected by the large methodological heterogeneity noted above**.** Thus, information on multimorbidity is not comparable across studies, and external validity is limited when comparing with the general population. For example, in European countries, the prevalence of having at least one chronic condition or health-related problem is high, overall one in four adults in 2011, varying from 18% to 45%, among persons between the ages of 16 and 64 years (Figure 3).

Additionally, according to the Survey of Health, Ageing and Retirement in Europe (SHARE), one in four adults (aged 50 years or over) has at least two chronic conditions (Börsch-Supan *et al.,*

2013b)(Figure 4), more than half of older adults (aged 59 and over) have three or more, and most primary care patients have coexisting conditions (Boyd *et al.,* 2007).

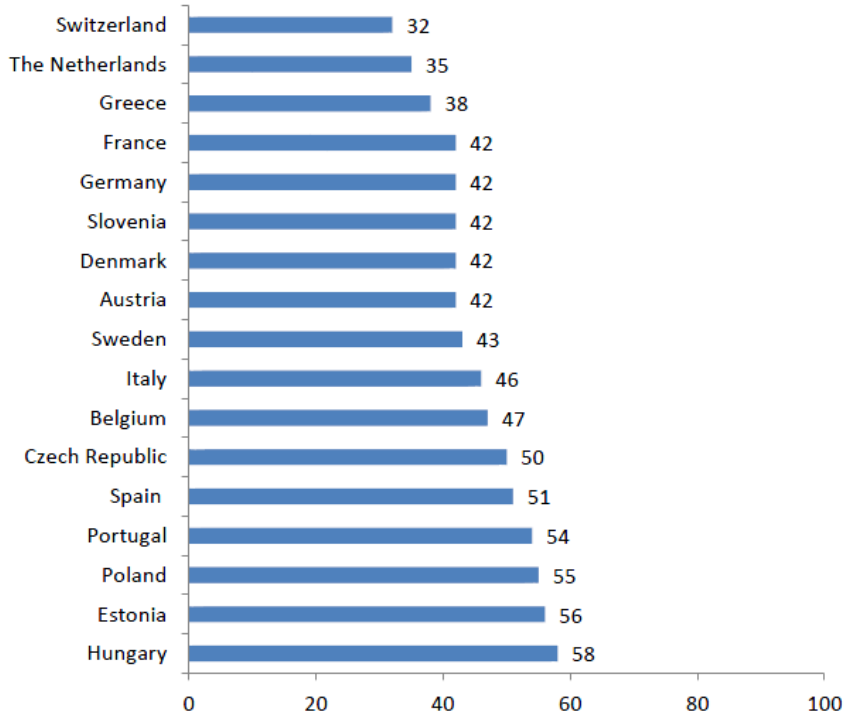
Multimorbidity prevalence estimates range from 13% to 83%, and 3.5% to 98.5% among older (aged over 59 years) and elderly adults (aged over 75 years) respectively, in primary care population across world countries (Fortin *et al.,* 2012; Salive, 2013). In high income countries, multimorbidity affects two thirds of older adults (aged over 65) and represents over 60% of total expenditures due to the related large use of health care services (Marengoni *et al.,* 2011; Parekh *et al.,* 2014).

Figure 3. Proportion of population (aged 16-64) reporting one chronic condition or health-related problem in European countries in 2011.



Source: Innovating care for people with multiple chronic conditions in Europe (ICARE4EU), July 2015. Data Source: Eurostat.

Figure 4. Proportion of adults (aged 50 years or over) reporting multiple health-related conditions in European countries in 2010-2011.

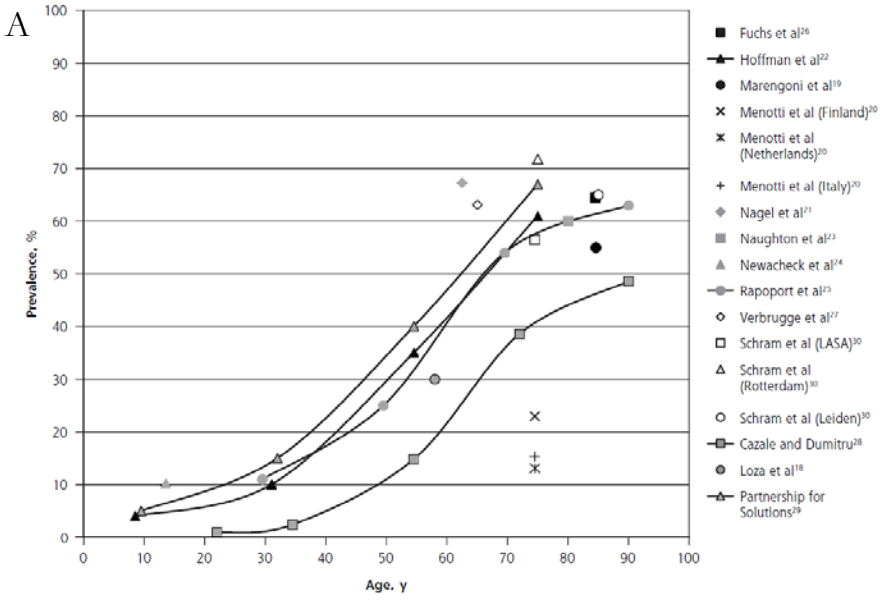


Source: Innovating care for people with multiple chronic conditions in Europe (ICARE4EU), July 2015. Data Source: SHARE

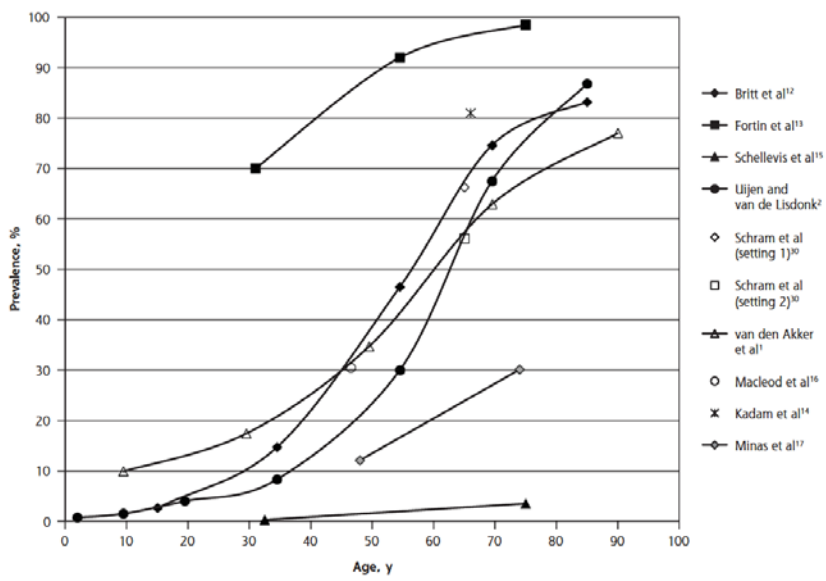
Concurrently, within a primary care population, the prevalence of multimorbidity also varies across the life course by gender, level of education, public health insurance and socioeconomic factors (van den Akker *et al.,* 1998; Salisbury *et al.,* 2011; Violán *et al.,* 2014). For instance, multimorbidity arises between 10 and 15 years earlier in lower social classes (Barnett *et al.,* 2012).

Research on multimorbidity, in both general population and primary care settings, has demonstrated that, although prevalence increases with age and is therefore highly prevalent among the elderly, it is not absent in younger groups (age <50 years) (Violán *et al.,* 2015). In fact, it can reach up to 25% and 35% prevalence rates in the general population and primary care settings, respectively (Fortin *et al.,* 2012a) (Figure 5). Even a 10% prevalence has been estimated in general practice in patients under 19 years of age (van den Akker *et al.,* 1998).

Figure 5. Prevalence of multimorbidity by age in general populations (A) and primary care settings (B).



B



Fortin *et al.,* 2012

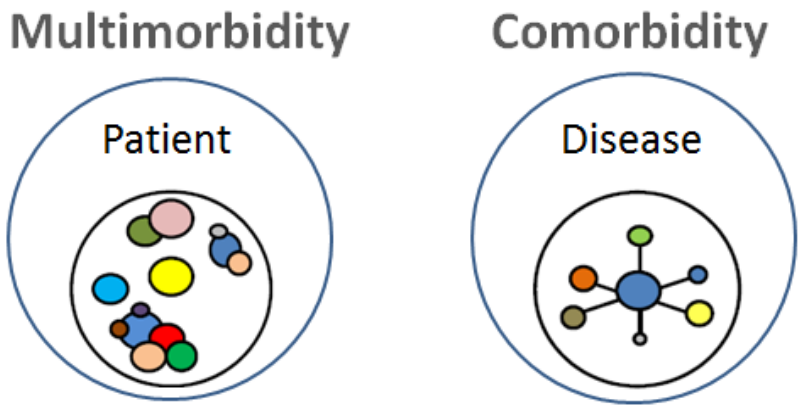
1.2.2 Multimorbidity patterns: from a single disease to a patient-centered approach.

Over the last decade, rather than focusing on single pathologies, patterns of medical care are evolving towards a more holistic approach, with increasing interest in the epidemiology of multimorbidity (Fortin *et al.,* 2007; Starfield, 2011)(Figure 6).

Traditionally, health care has focused on treatment of single diseases, without fully grasping the underlying patterns of co-existing chronic diseases and other health-related conditions and risk factors (i.e., health related behaviors and symptoms).

Barbara Starfield, in one of her editorials entitled "Threads and yarns: weaving the tapestry of multimorbidity", wisely used a metaphor to describe multimorbidity as a "tapestry of health" to point out the need to focus health services practice on the whole rather on individual diseases: *As any weaver knows, the elegance of a fabric lies in the yarns, not the threads. The whole is lots more than the sum of its parts. In health services, the threads are the diagnoses on which interventions are based. How these threads are spun into yarn (the underlying biodynamic of the tapestry of health) is poorly understood, to the detriment of efforts to understand the genesis of health problems and the interventions associated with them.* (Starfield 2006).

Figure 6. Co-existing health-related conditions: multimorbidity vs comorbidity approach.



Own elaboration. Figure: adapted from Calderón-Larrañaga A.

Co-existing health-related conditions cluster non-randomly in multimorbidity patterns based on their interaction and/or relationship in a given individual (Cornell *et al.,* 2009). Clustering of co-existing

health-related conditions is a dynamic phenomenon that changes over a lifetime and within age groups (Prados-Torres *et al.,* 2012).

Three groups of multimorbidity patterns have been described as the most common in several previous studies on non-random associations among diseases: cardiovascular and metabolic diseases, mental health problems and musculoskeletal disorders (Prados-Torres *et al.,* 2014; Violan *et al.,* 2014).

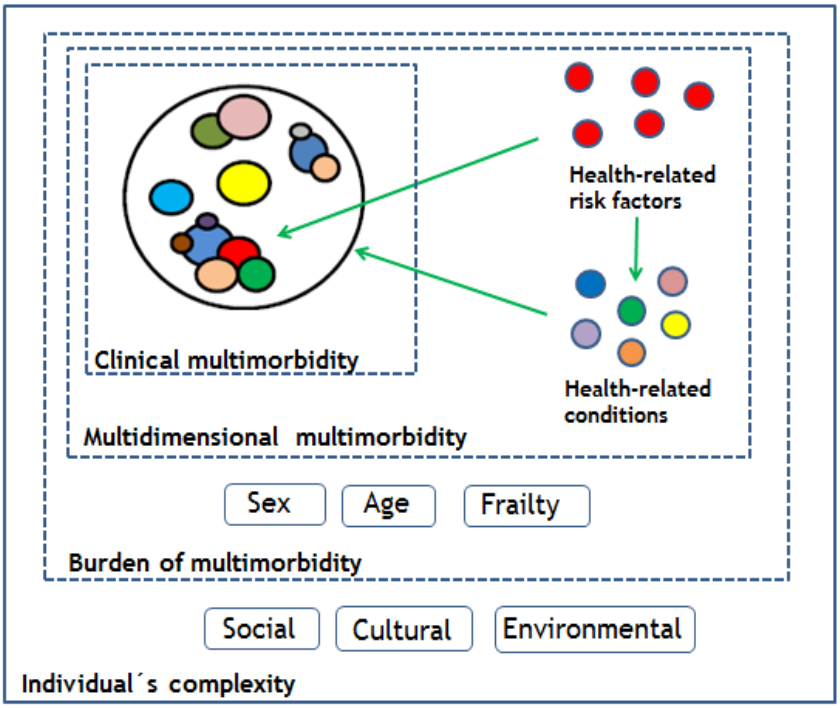
The main issue is not only to know the prevalence of co-existing health-related conditions, but also to understand the causal pathways through which different types of health conditions cluster at a specific point in lifetime in a specific population, as well as the sequence in which they appear and how these clustering patterns evolve over time.

Many people with multimorbidity cope well and do not require treatment or intervention, whereas others do so influenced by other non-health-related factors. Multimorbidity is built up in a complex multidimensional context where socio-cultural, environmental, and individual factors play a role in the manner and extent to which multimorbidity affects individuals (Valderas *et al.,* 2009) (Figure 7).

In this scenario, the relative severity of individual diseases should also be considered, since the burden of morbidity - the whole, the essence of illness- will be higher than the simple sum of individual diseases.

At the same time, health-related risk factors (e.g., obesity or health-related behaviors such as smoking, alcohol consumption, nutrition patterns or physical activity) play a role as causes of diseases that are interrelated. They can be the direct cause of a given disease, can be correlated but the cause of two different diseases, or can cause either disease without being correlated at all (Valderas *et al.,* 2009), making the co-ocurrence of those diseases more or less likely.

Figure 7. Conceptual framework for multimorbidity building.



Adapted from Valderas *et al*., 2009 and Calderón-Larrañaga A

In any case, health-related risk factors are related to a greater likelihood of adverse health outcomes (i.e., mortality, disability and chronic conditions), as well as to the onset of future multimorbidity (WHO, 2009). However, whether those risk factors impact the clustering of chronic conditions is an incipient idea to be further explored.

Few studies have explored the association between multimorbidity and isolated health-related risk factors such as obesity (Agborsangaya *et al.,* 2013), body mass index (Booth *et al.,* 2014), smoking and alcohol consumption (Nagel & Peter, 2008). In addition, the increased likelihood of multimorbidity due to the combined effect of health-related behaviors has been recently supported in a cross-sectional study by Fortin et.al. (Fortin *et al.,* 2014).

Through this more holistic approach, the assessment of multimorbidity demands objective and subjective measurements of disease burden (Bayliss *et al.,* 2012). Defining it from this multidimensional perspective that brings together co-existing chronic diseases and other health-related conditions (i.e., health related behaviors and symptoms) might be useful in creating a more comprehensive measure of multimorbidity that accounts for a significant burden of individual health status in any population.

1.2.3 Why measure multimorbidity in working populations?

To date, indicators of multimorbidity have largely been constructed on the basis of chronic health conditions or common diseases and mainly focused on patient and/or older populations. After the age of 45 years, the prevalence of chronic conditions increases along with a decline in perceived health status (Kessler *et al.,* 2001; Lerner *et al.,* 2005), quality of life (Fortin *et al.,* 2012) and functional capacity. All of this can negatively affect some occupational outcomes, such as employability, and work performance (Collins *et al.,* 2005). Despite this, multimorbidity is not only an issue for older populations since it is also found in younger age groups (Barnett *et al.,* 2012; Fortin *et al.,* 2012; Violán *et al.,* 2015).

In the workforce, however, chronic diseases might not be as prevalent as in more frequently studied populations, while certain unhealthy behaviors that are risk factors for later development of chronic health conditions are (Miller, 2011). The applicability of indicators of multimorbidity to other younger and healthier populations, such as the working population (Li & Sung, 1999), has not been well studied. Previous studies have shown the influence of multimorbidity on a wide range of outcomes, primarily focused on populations seeking health care, primary care, hospitalization and/or older populations (Smith *et al.,* 2008; Schäfer *et al.,* 2010; Aarts, 2012). Whether this influence persists in presumably healthier persons, such as those in a working population, is less well known.

Co-existing health-related conditions could also impact outcomes more relevant to occupational health, such as work ability, work functioning or sickness absence (Koolhaas *et al.,* 2014). Thus, for example, we know that duration of sick leave can vary for a given condition, depending on gender, age and presence of co-existing medical diagnoses (Ubalde-Lopez *et al.,* 2013). The adverse impact of multiple chronic conditions on occupational outcomes, such as sickness absence or work ability has been previously described (Koolhaas *et al.,* 2014; Casimirri *et al.,* 2014). However, individuals, usually older workers, were grouped based simply on the presence or absence, number or combinations of chronic conditions (Kessler *et al.,* 2001; Collins *et al.,* 2005) disregarding their severity.

Two studies (Papers 1 and 3) in this thesis propose two different methods to assign a severity measure to each health-related condition, when measuring multimorbidity. The first paper examines patterns of multimorbidity where health-related chronic conditions were weighted depending on how much they contribute to pattern variability. By applying an algorithm based on those weighted values we calculated a multimorbidity score. The third paper evaluates the impact of self-reported chronic health conditions on poor general health status, as an indicator of health-related quality of life. Chronic health conditions were weighted as severity scores related to their impact on poor general health from lower to higher. A multimorbidity score was then calculated by adding severity scores of workers reporting two or more chronic health conditions.

1.3 From working successfully to work absence

The presence and number of chronic conditions can affect employability, contributing negatively to the work participation of aging workers through reduced work ability. Interest in the relationship between aging and work demands, and its effects on working life, has been growing since the 1880s (Kohli *et al.*, 1983; Koskela *et al.,* 1984). By age 45 some mental capacities that involve processing information systems slow down (i.e., weakening of precision and speed of perception), but it is mainly physical capacities (cardiorespiratory and musculoskeletal) that begin declining. However, there are several false myths about aging and productivity. In work environments that account for the needs of aging workers, some mental capacities may improve with age due to positive interactions with the creative incorporation of one's work experience (i.e., growing seniority). In fact, work performance of older workers in terms of skill and speed demands have not been found to differ from that in younger workers (Spirduso, 1995).

From an occupational health point of view, the definition of aging workers often begins at age 45 or 50 years, due to better possibilities for early preventive measures. After age 50, most workers in physically and mentally demanding jobs experience a decline in self-perceived health and ability to work (Ilmarinen, 2001b; Lerner *et al.,* 2005). In the late 1990s, based on results of an 11-year longitudinal study of blue collar workers, the Finnish Institute of Occupational Health introduced the concept of work ability as an individual process of

human resources (individual health, skills, motivation, attitude and values) and work (demands, environment, community and management) (Tuomi *et al.,* 1997).

Aside from social policies, services and infrastructures needed to increase the employment rate of aging workers, there is a need to promote work ability at the worksite level by adjusting it to the needs of aging workers, who may be more vulnerable to the labor process (Ilmarinen, 2001; Baanders, 2002; Jones *et al.,* 2013). A recent review described factors other than those related to disease such as age, female gender role discrimination, and personal beliefs regarding return to work, that are negatively associated with work retention and return to work among workers with chronic diseases, regardless of diagnosis (Vooijs *et al.,* 2015a).

Efforts invested in improving work participation of aging workers should have positive results for society. Among these are less age discrimination, later retirement, lower unemployment and health care costs, and better welfare. Companies should see improvements in productivity, competitiveness and management, lower work disability costs, and less sickness absence. And individual workers would experience better health and quality of life, improved functional capacity, competitiveness, work ability and a lower risk of unemployment.

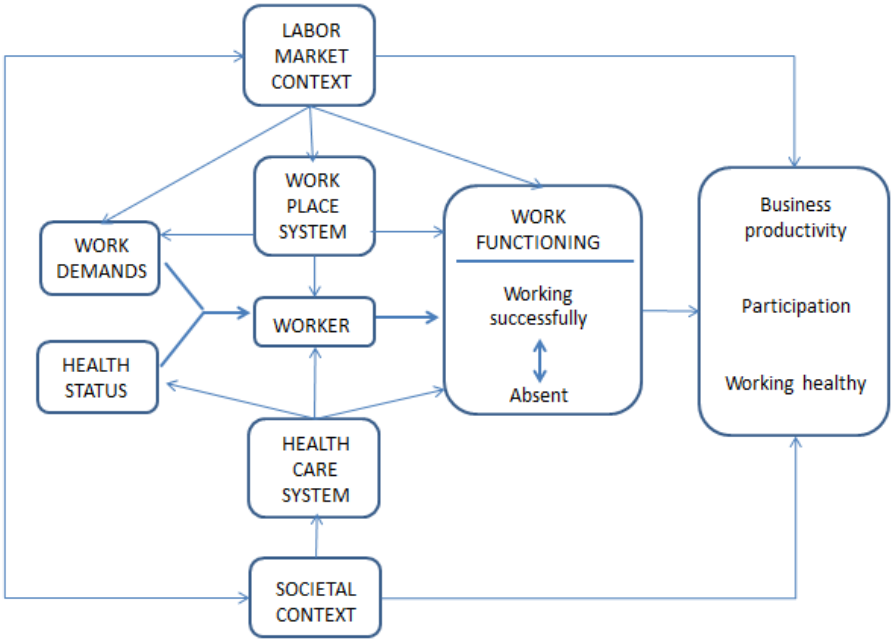
1.3.1 Work functioning

Besides the likely negative effect of aging on work ability, and considering the current context of increasing co-existing chronic conditions among the workforce, it is worth examining the extent to which a given health-related problem may interfere with the ability of workers to accomplish their job tasks. An individual´s work functioning, defined as the ability to meet work demands given a health status is reflected by the balance between these two dimensions (Amick & Gimeno, 2008). It represents a continuum varying from working successfully in a productive and healthy way (i.e., ability to meet all work demands) to work absence (i.e., inability to meet any work demand) (Figure 8). Short and long-term sickness absence (absence from work due to health related problems) and presenteeism (working while sick) are examples of occupational health-related outcomes that are a part of this continuum.

In work functioning, the direct stakeholders are those related to the workplace (employers, managers and supervisors) and health care systems (primary care and occupational physicians within the Spanish context). Employers, human resources managers and supervisors have a responsibility to consider accommodations needed to maintain a healthy and sustainable stay at work or a successful return to work. On the other hand, health professionals are in charge of the treatment and case management role which will guide and boost workers to a healthy and safe return to work following a sick leave.

Labor market, healthcare system, regulations and economic policies define a societal context that affects the relationship between health and the workplace. In turn, these structural factors may also directly determine individual´s health status and work demands. This may then affect work functioning, business productivity and an individual's work participation.

Figure 8.Conceptual model of Work Functioning.



Adapted from Amick, 2008 & Abma, 2012

To measure the impact of health on work functioning different validated instruments, such as the Work Role Functioning Questionnaire (WRFQ), are available. The WRFQ measures perceived limitations in meeting work demands due to physical or emotional

problems (Amick *et al.,* 2000). The original instrument consists of 27 items in five subdomains: 1) work scheduling demands, 2) output demands, 3) physical demands, 4) mental demands and 5) social demands. Response options vary from 0% (limited none of the time), 50% (limited half of the time) to 100% (limited all of the time) (Abma *et al.,* 2013). Commonly scores are converted to a 0 to 100 score scale, with higher scores indicating better work functioning. The original U.S. version of this instrument has been successfully cross-culturally adapted and translated to other languages and cultures, including Canadian French (Durand & Vachon, 2004), Dutch (Abma *et al.,* 2012) and Spanish spoken in Spain (Ramada *et al.,* 2013; Ramada *et al.,* 2014).

The main reason to use these instruments is to estimate lost productivity and economic costs due to health-related reasons when an individual is present at the workplace. By using this approach to functioning when an individual is working, rather than focusing on absences, distinct goal points can be identified that may help develop more effective prevention strategies and interventions.

While return to work (RTW) after sick leave has been extensively studied, there is little knowledge about how workers function after they have returned to work. They may still be impaired, cope with health-related limitations and function less, resulting in reduced job performance and productivity at work. Although different interventions have been developed to facilitate RTW (Arends *et al.,* 2012; Hoefsmit *et al.,* 2012) and reduce recurrent sick leave after RTW,

the course of work functioning over time after RTW has not been previously assessed (Arends *et al.,* 2010; Arends *et al.*, 2014).

Chronic health conditions can limit the ability to carry out specific work demands and function at the workplace. Previous studies have shown that the number of chronic health conditions increases the risk of physical and psychosocial work limitations (Lerner *et al.,* 2000). Moreover, an incremental effect across combinations of the number and type of chronic health conditions on predicting sick leave and work-related impairment has been also described (Kessler *et al.,* 2001). A growing body of literature has shown the negative impact of chronic health conditions, not only on work functioning but also on staying at work, sickness absence and work disability. However, less is known about whether chronic diseases impact the course of these indicators over time. In addition, the relationship of the WRFQ and health status measurement such as multimorbidity has not been previously addressed.

Until now, studies analyzing the impact of chronic health conditions on different occupational outcomes have generally examined a single, specific health condition (Abma *et al.,* 2013; Aaviksoo *et al.,* 2013; Vuong *et al.,* 2015). Few have considered the effect of multiple coexisting chronic conditions on occupational outcomes such as sickness absence and work performance (Collins *et al.,* 2005; Casimirri *et al.,* 2014), and none have focused on the course of work functioning over time. In the first and second paper of this thesis we constructed a score of multimorbidity and tested its predictive ability for sickness

absence episodes and their duration. In the third paper we developed a novel approach to evaluating the role of multimorbidity on work functioning over time, measured through the WRFQ, of workers who had returned to work after a sick leave. Serially assessing workers' self-perceived health-related work functioning, using instruments like the WRFQ, after return to work may help identify workers who need support to stay at work, and to develop appropriate interventions.

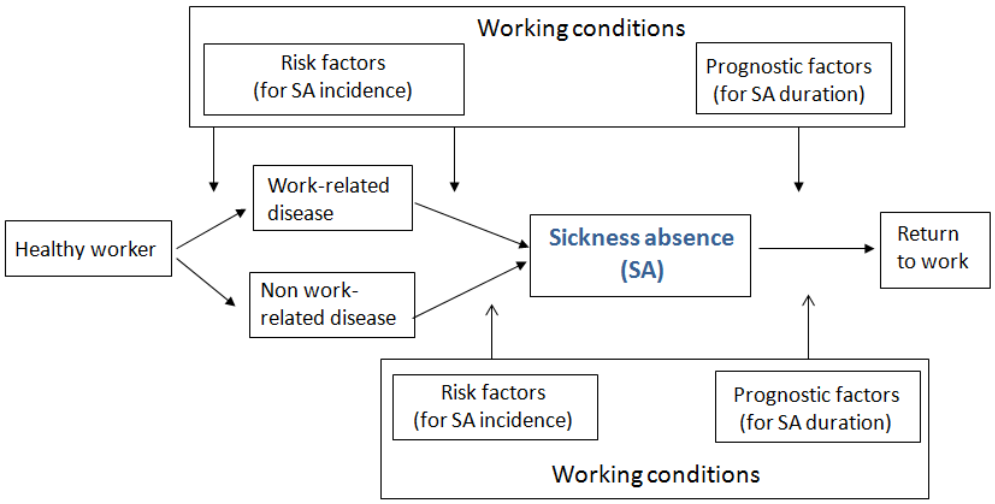
1.3.2 Sickness absence: more than an indicator of ill health

Sickness absence, i.e., a certified absence to work due to health-related limitations, represents a major health and socio-economic problem across countries. Sickness absence has a substantial impact on health care and on economic and personal costs. In the mid-2000s, sickness absence represented between 4% and 5% of the gross domestic product for some of the OECD, together with permanent disability (OECD, 2009). In Western Europe, average absence rates range from 3% to 6% of working time (Eurofound, 2010). In Spain, however, a clear decreasing trend of Social Security System expenditures on direct benefits payments was observed during and after the crisis period, from 8 M€ in 2009 to 5.5M€ in 2014 (Ministerio de Empleo y Seguridad Social. Gobierno de España).

The relationship between health and work is bidirectional, where working conditions are determinants for health, but a given health

status may also affect work performance, work ability and employability. Rather than being viewed as merely an indicator of ill health, sickness absence can also be understood as an integrated indicator of functioning reflecting the joint influence of social and work demands and health (Marmot *et al.,* 1995). Although a given health problem can be non-work related in origin, working conditions are essential in the relationship between workplace and health, since work tasks might be unfeasible and hazardous, leading to future work absences that in turn may be prolonged, delaying return to work (Sampere *et al.,* 2011a)(Figure 9).

Figure 9.Theoretical model of the natural history of sickness absence



Adapted from Benavides *et al.*, 2001

In Spain, sickness absence certification is initiated and terminated by primary care physicians in the national health service with a distinction between work-related and non-work related episodes based on legal criteria and medical judgment. Medical management of sickness absence episodes is one of the most common reasons for visits in primary care settings (Gérvas *et al.,* 2006). In this sense, not only the economic but also the associated social consequences need to be considered at the health services level (e.g., increase in the number of primary care visits, longer waiting list for treatments and diagnostic tests), in the work environment (e.g., work re-organization, changes in productivity) and at the individual worker level (e.g., loss of income, isolation from the usual workplace and loss of familiarity with work duties while absent).

To prevent the occurrence of future sickness absence episodes, as well as to reduce time absent from work, assuring a healthy, safe and sustainable return to work, a deeper knowledge of the determinants influencing sickness absence incidence and duration is needed.

Sickness absence is not merely a health-related and isolated situation; it should be placed within a complex context. Sickness absence can be explained from complementary perspectives where economic situation, the labor market structure, health system and social benefit system policies knit the basis framework in which workplace, socio-cultural and other individual factors play a role as determinants of sickness absence closer to the individual level (Benavides, 2006)(Figure 10).

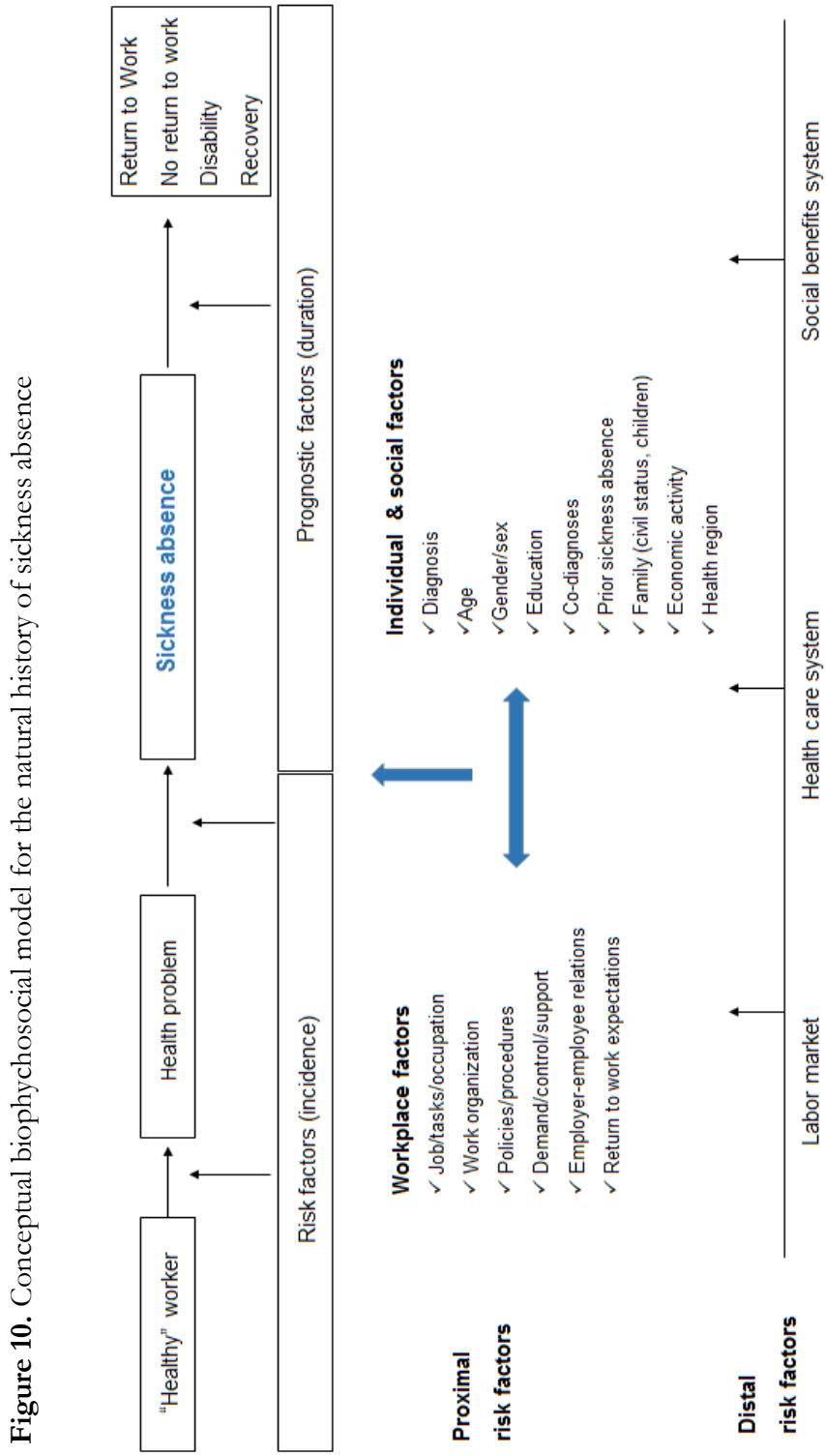


Figure 10. Conceptual biophychosocial model for the natural history of sickness absence

We already know from the literature that individual (age, sex, cultural beliefs, health behaviors comorbidities), sociodemographic (gender, marital status, health region) and workplace factors (working and employment conditions, work environment) are interrelated and affect the risk of future work absences (risk factors) and its duration (prognostic factors). Other distal factors such as labor markets, health care and social security systems (e.g., type of sickness absence benefits system and case management) provide the structural foundation for the evolution of these interactions (Mastekaasa, 2000; Gimeno *et al.,* 2004; Benavides *et al.,* 2007; Tora Rocamora *et al.,* 2010; Sampere *et al.,* 2011a; Sampere *et al.,* 2011b; Gimeno *et al.,* 2014).

While work-related and sociodemographic determinants of sickness absence have been extensively studied (Gimeno *et al.,* 2004; Mastekaasa, 2005), those related to worker health status have received less attention. For instance, clinical diagnoses causing sickness absence episodes are well established as a prognostic factor for duration (Delclós *et al.,* 2010), as are co-diagnoses arising during a sickness absence episode (Ubalde-Lopez *et al.,* 2013) or worker self-perceived health (Sampere *et al.,* 2011b). This is despite chronic health conditions being identified as key determinants of an increase in work-related absences, which are responsible for a substantial part of the burden on labor costs (Collins *et al.,* 2005; Casimirri *et al.,* 2014).

Whereas the impact of a single or specific chronic health conditions on various different occupational outcomes has received broad attention (Abma *et al.,* 2013a; Boot *et al.,* 2013), few studies, mostly

cross-sectional, have addressed the effect of the co-occurrence of multiple chronic conditions on sickness absence (Rogers & Hagberg, 1990; Kessler *et al.,* 2001; Collins *et al.,* 2005; Vuong *et al.,* 2015). Where this was done, this effect was generally estimated by grouping individuals based on the presence/absence of selected chronic health conditions (Aaviksoo *et al.,* 2013), having two or more chronic conditions (Casimirri *et al.,* 2014; Vuong *et al.,* 2015) ,their number (Koolhaas *et al.,* 2013), or several combinations of those conditions (Kessler *et al.,* 2001) among older workers. Although most workers with chronic health conditions are able to work without accommodations or restrictions, they are more likely to have health-related limitations and disabilities than "healthier" workers (Abma *et al.,* 2013a).

From an occupational health perspective, aside from chronic conditions and multimorbidity, prior sickness absence episodes should be considered part of previous health status**,** as they have been found to be a strong predictor of risk for future episodes (Roelen *et al.*, 2011). Such a health status, when unbalanced with work demands, may directly affect the pathway from working successfully to work absence, increasing the risk for a sick leave, delaying and/or hampering a sustainable and successful return to work (Figure 11).

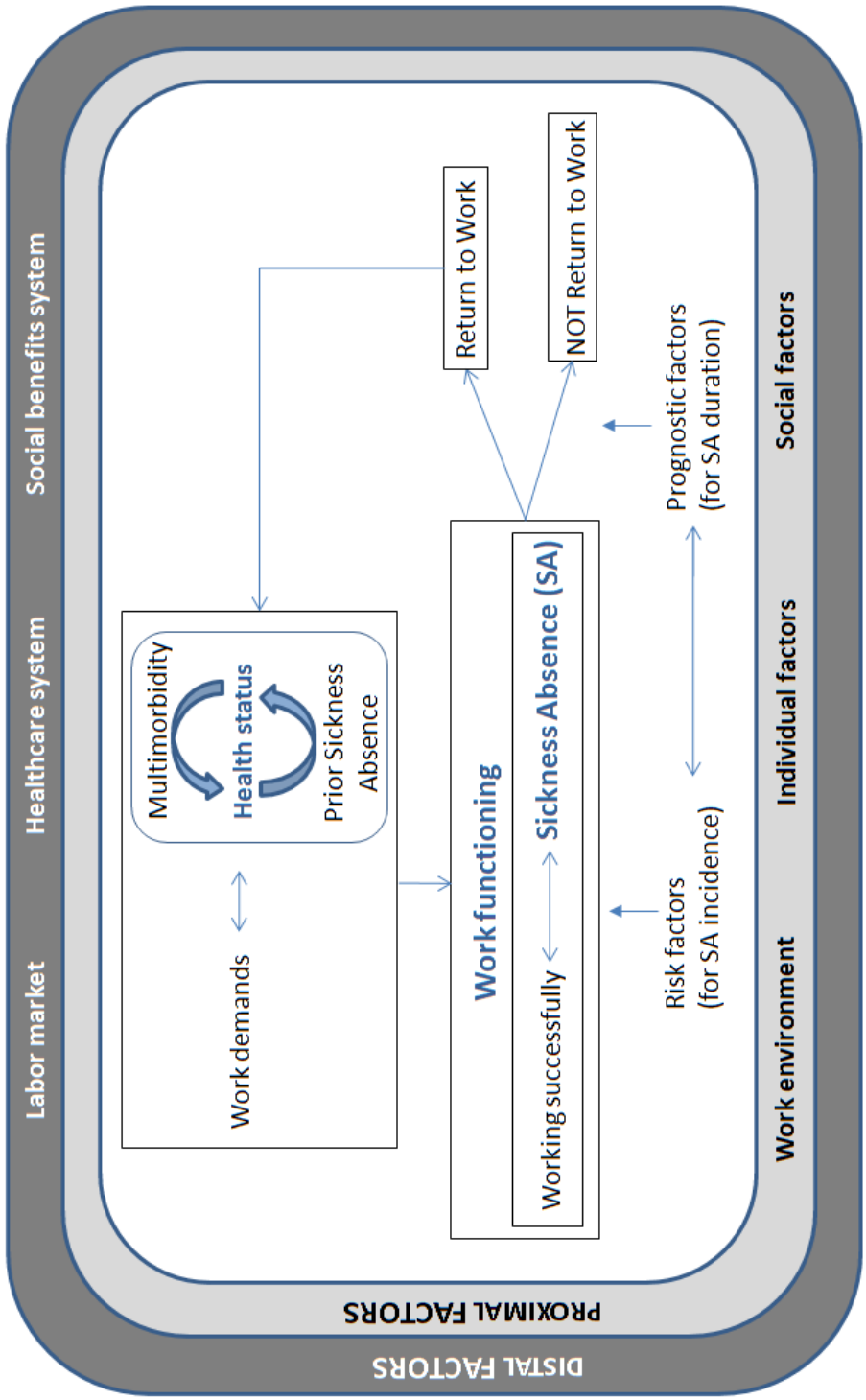


Figure 10. Proposed conceptual framework model of how worker´s health status (i.e., multimorbidity and prior sickness absence) influences in the pathway from working successfully to work absent.

This conceptual model shown in Figure 11 formed the basis for the three studies that conform this thesis. We first looked into the likelihood of a predictive effect for a given health status (shaped by multimorbidity and prior sickness absence episodes) on overall sickness absence incidence (paper 1). In the next paper, we went further and examined incidence and duration for specific sickness absence diagnosis subgroups (paper 2). Finally we analyzed whether ability to meet work demands (i.e., work functioning) after return to work was affected by multimorbidity, and to what extent (paper 3).

1.4 Justification

Projections on workforce aging point out the importance of adapting labor markets, social security and health systems, as well as work environments, to obvious emerging needs and challenges in occupational health.

The steeply continuous increase of co-existing chronic conditions bound to aging (i.e., multimorbidity) necessarily leads to a change from a focus on single diseases to a more holistic individual-centered approach. This encompasses a search for multimorbidity patterns and the way they affect ability to work through various mental and physical function changes arising during the working life. Most previous studies have mainly centered on patient and/or elderly populations; few have explored patterns of multimorbidity, and less attention has been paid to other healthier and younger populations, such as workers.

The relationship between a given health status and work demands determines the pathway from working successfully, in a healthy and productive manner, to work absence. Since chronic conditions are most likely related to a decreased general health status and a hindered ability to meet work demands, leading to future sickness absence, there is a need to investigate more in order to improve work participation and retention of aging workers.

Measuring multimorbidity in working populations may help identify

workers at risk of future sickness absence, who experience a delayed return to work, or have returned to work and might need special attention. In addition, it may help design interventions for more sustainable workplaces and project future sickness absence episodes and associated costs among workers with multimorbidity.

This thesis intends to contribute, with empirical evidence, to a better understanding of whether, and to what extent, prior health status (understood from a holistic and comprehensive perspective) is related to decreased work performance and an increased risk of future absences from work.

2

Hypothesis and objectives

Look for the answer inside your question

~ Rumi

2 HYPOTHESIS AND OBJECTIVES

2.1 Hypothesis

Multimorbidity in working populations is related to an increase in the incidence and duration of sickness absence and affects work functioning after return to work from a sickness absence episode.

2.2 Objectives

2.2.1 Objective 1

Paper 1: "Measuring multimorbidity in a working population: the effect on sickness absence."

- To construct a non-outcome centered multidimensional multimorbidity score based on examining the relationship between health-related conditions (i.e., chronic conditions, symptoms, and health behaviors).

- To test the predictive ability of the multidimensional multimorbidity score for occupational outcomes in working populations such as sickness absence.

2.2.2 Objective 2

Paper 2: "Multimorbidity and sickness absence: the effect on incidence and duration by specific diagnoses."

- To examine the effect of multimorbidity on incidence and duration of sickness absence episodes due to three common, high-cost diagnosis groups: musculoskeletal disorders, mental health disorders and cardiovascular diseases.

2.2.3 Objective 3

Paper 3: "Beyond return to work: the effect of multimorbidity on work functioning trajectories after sick leave due to common mental disorders."

- To assess the longitudinal impact of multimorbidity on work functioning trajectories, over time, among workers who had returned to work after sick leave due to common mental disorders.

3

Methods

I have never tried that before,
so I think I should definitely be able to that.

~Pippi Longstocking
by Astrid Lindgren

3 METHODS

3.1 Study population and ethical approval

3.1.1 Papers 1 & 2

The study population consisted of 372,370 workers registered with the Spanish social security system and covered by one of the largest state health mutual insurance companies (*mutua)*. In 2006, these workers underwent a standardized medical evaluation by occupational health professionals ("*prevention service"*) for general health surveillance purposes.

The study proposal was reviewed and approved by the Clinical Research Ethics Committee of the Parc de Salut Mar in Barcelona, and an agreement assuring participant confidentiality was signed by all stakeholders. Data were treated confidentially in accordance with current Spanish legislation on data protection. All data were de-identified before being delivered to the research team. All participants gave informed consent for their data to be included in the study.

3.1.2 Paper 3

The study population consisted of 156 Dutch employees who returned to work after a sick leave episode due to a common mental disorder, and were followed for 12 months.

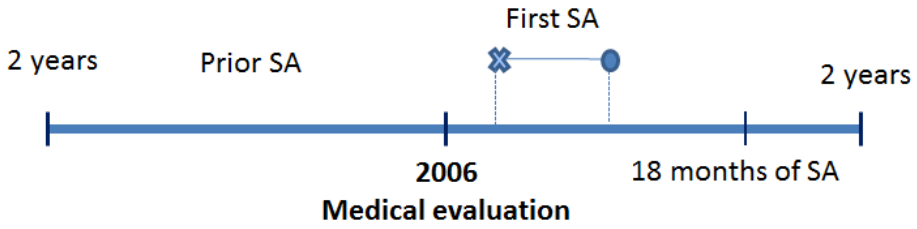
Eligible employees were asked to participate in the study and provided written informed consent. The study protocol was reviewed and approved by the Medical Ethics Board of the University Medical Center Groningen.

3.2 Study design Papers 1 & 2

3.2.1 Follow up

Observational longitudinal study, with the start of follow-up set at the time of the standardized medical evaluation in 2006. Participants were followed for up to two years, either until the closure of a first (incident) sickness absence episode, the maximum legal duration in Spain for sickness absence (18 months) or the end of the study period (24 months) (Figure 12).

Figure 11. Follow-up period for sickness absence (SA) in Papers 1 & 2.



Retrospective information on sickness absence episodes occurring within the two years prior to the 2006 medical evaluation, incident sickness absence and other sociodemographic variables were obtained

from the official Spanish social security system sickness absence registry.

3.2.2 Study variables

Paper 1

Standardized medical evaluations during 2006 were performed by occupational physicians, and included completion of a uniform questionnaire and measurement of body mass index (BMI) as part of the physical examination. The questionnaire included sex, age and occupation, coded using the Spanish National Classification of Occupation (CNO93). Data were collected on prior diagnoses of chronic conditions (hypertension, hyperlipidemia, diabetes, venous thrombosis, coronary artery disease, cerebrovascular disease and/or peripheral vascular disease), health behaviors (tobacco and alcohol consumption), and selected symptoms (headache, fatigue, sleep disturbances, neck and low back pain). By applying an algorithm, these questionnaire variables were used to construct a sex-specific multidimensional multimorbidity score (MDMS).

Paper 2

The main outcome variables were incidence and duration (end date of the episode minus the start date + 1 day) of the first sickness absence episode arising after the 2006 medical evaluation due to specific diagnoses groups. Medical diagnoses were coded using the 9th Revision of the International Classification of Diseases (WHO, 1978) and classified into three common, high-cost diagnosis groups:

cardiovascular diseases [ICD9 390-459], musculoskeletal [ICD9 719-739] and mental disorders [ICD9 290-310].

The main independent variable was the MDMS, which ranged from zero (no multimorbidity) to 100 (high multimorbidity). Individuals with multimorbidity (i.e., two or more health conditions) were grouped into tertiles of MDMS from low, medium to high multimorbidity levels. In addition, we categorized those without MDMS into two groups: none or one health condition. Prior sickness absence episodes were grouped by their number into three categories (0, 1 to 4, or ≥ 5) based on their distribution.

3.2.3 Final sample: Papers 1 & 2

For sickness absence incidence, the final sample for statistical modeling (n=236,500 men and 91,440 women) excluded workers on sick leave during the medical evaluation, those lacking insurance coverage before the medical evaluation or the new sickness absence episode, and those with missing data on key variables. For sickness absence duration, the final sample (17,083 men and 7,269 women) excluded workers with no sickness absence episodes during the follow up, and those with episodes lasting longer than the legal duration for sickness absence episodes recognized by the National Security System (>548 days).

3.3 Study design Paper 3

Participants were recruited between January 2010 and June 2011 as part of a cluster-randomized controlled trial (cluster-RCT) study ("SHARP-at work") focused on the implementation and evaluation of an at-work intervention to prevent recurrent sickness absence after sick leave for a CMD (Arends *et al.,* 2010). Recruitment was carried out by occupational physicians (OPs) from one of the largest occupational health services in the Netherlands.

Diagnoses were coded by the OPs according to the Classification of Diseases in Dutch, based on the ICD-10 International Classification of Diseases. Once included in the study, employees were followed-up at three, six and 12 months after RTW.

3.3.1 Study variables

Main variables

Work Functioning

Work functioning was measured at baseline and at three, six and 12 months after RTW, using the cross-culturally adapted, translated and validated 27-item Dutch version of the Work Role Functioning Questionnaire (WRFQ). Item response options were scored on a 5-point Likert scale from 0% (none of the time), 50% (half of the time) to 100% (all of the time). Scores were converted to a 0 to 100 score scale, with higher scores indicating better work functioning.

Multimorbidity

Multimorbidity was defined as having two or more chronic health conditions, and was measured at baseline. Chronic health conditions were self-reported at baseline, in response to a list of 13 system-specific diagnosis groups: injuries, musculoskeletal, mental, cardiovascular, respiratory, neurological, digestive, urogenital, skin, endocrine/metabolism, blood and congenital diseases and tumors. Self-reported weight and height were used to calculate BMI; obesity was defined as a BMI≥30 kg/m^2. We first examined the severity of each diagnosis group by assessing their impact on poor general health status. Next, self-reported chronic health conditions were weighted as severity scores related to their impact on poor general health: from 1=low, 2=intermediate to 3=high. In a final step, a multimorbidity score (MMBS) was calculated by summing severity scores of workers who reported two or more chronic health conditions.

Covariates

Demographic factors (age, sex and educational level), intervention group (intervention or usual care), and health-related behaviors (physical activity, alcohol and smoking) were measured at baseline.

3.4 Statistical analysis

3.4.1 Papers 1 & 2

Construction of the MDMS was developed in two steps. First, in order to detect clustering patterns among health conditions, we ran a

multiple correspondence analysis (MCA), with the joint method (JCA) that included chronic conditions, symptoms, and health behaviors. The JCA method of the MCA corrects the percentages of the explained variance obtained with MCA, and can be interpreted as a factor analytic model or a generalization of principal component analysis. Two key parameters are provided by the MCA: inertia (i.e., percentage of explained variance for each dimension or axis obtained) and the contribution of the variable category (i.e., absolute, or the inertia relative to the principal inertia on an axis; and relative, or the inertia relative to the inertia of a category). In a second step, we developed an algorithm based on the contributions of the categories for each of the variables weighting significantly in the dimensions obtained from the JCA. The final MDMS was the sum of the value for the weighted absolute contributions (i.e., dimensions scores x inertia) of each dimension obtained.

In a final step in Paper 1, the MDMS, together with sickness absence episodes occurring in the two years prior to the 2006 medical evaluation, was used to fit crude and adjusted Cox models for age and occupational social class, to test its ability to predict new first sickness absence episodes, expressed as the crude (HRc) and adjusted (HRa) hazard ratios and corresponding 95% confidence intervals (95% CI).

For Paper 2 we again fit crude and adjusted Cox models for covariates, to assess the association between MDMS and both incidence and duration of first sickness absence episodes arising

during the follow-up period, for the three specific diagnosis groups: cardiovascular diseases, musculoskeletal and mental disorders.

The proportional hazards assumption was examined via Kaplan-Meier curves and tested by including interaction terms between each predictor and the logarithm of the follow-up period. We found no meaningful interactions, so the final models were computed without including interactions. All analyses were conducted separately for men and women, using Stata/MP v.13© (StataCorp, College Station, Texas).

3.4.2 Paper 3

To measure the impact of each self-reported chronic condition and poor general health status, we fit logistic regressions adjusting for age, sex and health-related behaviors. Severity scores for diagnosis group ranged from 1 to 3, as mentioned above, and were based on the magnitude of the adjusted odds ratios (aORs) obtained as follows: 1 for aORs from 0 to 1, 2 for aORs from >1 to 2 and 3 for aORs over 2.

Trajectories of work functioning scores were identified based on four measurement waves- baseline, three, six and 12 months- using latent class growth analysis (LCGA). LCGA identifies differentiated subpopulations (latent classes), each with its own specific longitudinal trend. Trajectories were adjusted for the MMBS as a class-trajectory modifier within each trajectory, as well as for age, sex, educational

level and intervention group (equal effect across classes). The MMBS was also included as trajectory class membership predictor.

The statistical analyses were conducted using LatentGold© 4.5 (Statistical Innovations, Belmont, California) for LCGA, and IBM© SPSS© Statistics v.19.0 (IMB Corp, Armonk, New York) for descriptive analyses.

4

Results

Not everything that counts can be counted,
and not everything that can be counted counts

~Albert Einstein

4 RESULTS

4.1 PAPER 1

Ubalde-Lopez M, George L. Delclos GL, Benavides FG, Calvo-Bonacho E, Gimeno D. Measuring multimorbidity in a working population: the effect on incident sickness absence. Int Arch Occup Environ Health, 2015, DOI: 10.1007/s00420-015-1104-4.

Ubalde-Lopez M, Delclos GL, Benavides FG, Calvo-Bonacho E, Gimeno D. Measuring multimorbidity in a working population: the effect on incident sickness absence.Int Arch Occup Environ Health. 2016 May;89(4):667-78. doi:10.1007/s00420-015-1104-4

4.2 PAPER 2

Ubalde-Lopez M, George L. Delclos GL, Benavides FG, Calvo-Bonacho E, Gimeno D. Multimorbidity and sickness absence: the effect on incidence and duration by specific diagnoses.

Occupational Medicine (London)

Minor comments, final re-submission (29th February 2016)

Publicat amb el títol:

Ubalde-Lopez M, Delclos GL, Benavides FG, Calvo-Bonacho E, Gimeno D. The effect of multimorbidity on sickness absence by specific diagnoses. Occup Med (Lond). 2016 Aug 5. pii: kqw092.
doi: 10.1093/occmed/kqw092

4.3 PAPER 3

Ubalde-Lopez M, Arends I, Almansa J, Delclos GL, Gimeno D, Bültmann U. Beyond return to work: the effect of multimorbidity on work functioning trajectories after sick leave due to common mental disorders.

Journal of Occupational Rehabilitation
Minor comments, final re-submission (29th February 2016)

Ubalde-Lopez M, Arends I, Almansa J, Delclos GL, Gimeno D, Bültmann U. Beyond Return to Work: The Effect of Multimorbidity on Work Functioning Trajectories After Sick Leave due to Common Mental Disorders. J Occup Rehabil. 2016 Jun 1. DOI: 10.1007/s10926-016-9647-0

5

General discussion

I have no special talents.
I am only passionately curious

~Albert Einstein

5 GENERAL DISCUSSION

This doctoral thesis presents a novel multidimensional approach to assessing the health status of working populations and measuring its impact on key occupational outcomes, sickness absence and functioning after return to work (RTW). Rather than simply estimating prevalence rates, we examined the health status of two different working populations by calculating a score based on: 1) the relationships (i.e., multimorbidity patterns) among several health-related conditions (chronic diseases, health behaviors and symptoms and 2) counting severity-weighted chronic health conditions, regardless of a specific outcome.

5.1 MAIN FINDINGS

5.1.1 Heterogeneity in chronic conditions and multimorbidity prevalence estimates

Measuring multimorbidity is challenging since prevalence estimates vary depending on the target population and the type and number of health-related conditions considered.

In the Spanish context we found that, among workers attending standardized medical evaluations focused on illness and injury prevention, one woman for every two men reported one health-related condition. The proportion of people with multimorbidity (i.e., two or more health-related conditions) was six times higher in men (12%) than

women (2%) but lower than what has been reported in the Spanish adult (50 years or older) general population (51%). In contrast, the prevalence of multimorbidity among Dutch workers, who had returned to work after a sick leave due to a common mental disorder (CMD), was high (44%) compared to that in the Dutch general population age 50 years and above (Börsch-Supan *et al.,* 2013a).

This is not surprising for several reasons. First, within our Spanish study population some degree of selection bias, due to a potentially "double" out-selection caused by the healthy worker effect, may have underestimated the prevalence of multimorbidity. Reasons for undergoing the medical evaluations were diverse, but mainly ranged from voluntary routine periodic exams to determination of fitness-for-duty before entering a job or following a sick leave. Workers undergoing a health examination tend to be healthier and possibly more motivated to know their health status than the general or other populations (Li & Sung, 1999; Loeppke *et al.,* 2010).

Second, regarding the Dutch population, many morbidities have been linked to mental disorders. Almost 80% of CMD patients have at least one other co-occurring health-related condition, and co-existing physical health problems are known predictors for the onset and persistence of CMDs (WHO, 2001). Lastly, the nature of health-related conditions available in both studies differed. While in our Spanish population a large portion of the available information centered on cardiovascular factors, and data on other common health conditions (e.g., mental, musculoskeletal disorders or cancer) (Diederichs *et al.,*

2011) were not collected, in the Dutch context there was a wider range of other high-cost diagnosis groups.

Operationalizing a multimorbidity measurement is hampered by the lack of consensus or gold standard for defining and measuring multimorbidity. The number and type of chronic conditions included, as well as the nature of the target population, are key to determining multimorbidity prevalence. For this reason, prior research on multimorbidity, mostly focused on patient populations and the elderly, has shown wide ranges and high variability in prevalence rates. In addition, multimorbidity indices are mainly used to predict specific outcomes, based on *a priori* weighted schemes. When used in this manner, multimorbidity indices are useful for the specific outcome they are designed to capture and may facilitate comparability. However, they may be of limited use to reflect the effect of multimorbidity on a population as a whole. Our findings support the idea that the application of multidimensional and outcome-independent measurement tools is useful to better typify working populations in different settings.

5.1.2 Multimorbidity patterns

Rather than only including chronic conditions, a multidimensional multimorbidity measure (i.e., the MDMS) that combines chronic health conditions, health-related behaviors and symptoms, when applied to presumably healthier working populations, is likely to be more sensitive in detecting a larger proportion of workers with at least one morbidity.

In contrast to previously developed multimorbidity measures, generally aimed at older and typically less healthy populations, we created a new multidimensional multimorbidity score (the MDMS) that is more suitable for use in younger, and presumably healthier, working populations. Although it is well known that morbidity increases with age, it is not just an issue of the elderly, but also worth considering in younger groups. Patterns of risk factors, health conditions, and multimorbidity prevalence can vary along the life course as well as within age groups (Taylor *et al.,* 2010; Prados-Torres *et al.,* 2012); hence, it is reasonable to consider multimorbidity as a dynamic phenomenon that evolves over time. In both women and men, at early ages, there are risk factors and behaviors that likely predispose to the development of chronic disease in the middle part of life. And in later stages, complications from these diseases can take on a dominant role, at a high cost to both individuals and society. For many cardiovascular and metabolic diseases, these patterns are well established, e.g., the effect of hypercholesterolemia and smoking in coronary artery disease, or obesity in diabetes (Prados-Torres *et al.,* 2012; Violan *et al.,* 2014). In other cases, the relationships are less evident.

Risk factors are considered the starting point for future morbidity, but the decision to include them in multimorbidity measures is admittedly controversial (Guthrie *et al.,* 2012). Although it is unclear whether risk factors impact how diseases cluster, a recent study found obesity, as a predictor of multimorbidity, to have a role in the clustering of chronic conditions (Agborsangaya *et al.,* 2013). The expected increase in major risk factors (Vaughan-Jones, 2009), strongly associated with

unfavorable health states and a higher number of chronic health conditions (Surís *et al.,* 2008; WHO, 2009), points to the need for their inclusion in the concept of multimorbidity, at least in younger, healthier populations. Our initial evaluation of its predictive ability suggests it can help identify people at risk, and thus prevent, delay, and/or mitigate the onset of future health conditions. By identifying these at-risk groups earlier, interventions could be designed to promote healthier habits which could impact future sickness absence and other adverse outcomes.

Clinically logical relationships among health-related conditions revealed patterns of multimorbidity consistent with those previously found in older and patient populations. Regarding its composition, our findings revealed two dimensions that may help inform the burden and distribution of multimorbidity beginning at an earlier point in adult life. The first dimension was conformed by highly related cardiovascular risk factors and health behaviors. The second dimension grouped pain symptoms (i.e., in headache, neck and back) and sleep disturbances, which are often associated with decreased self-perceived and mental health (Pikó *et al.,* 1997; Ohayon, 2002).

These results are in overall agreement with prior research on multimorbidity patterns in both working and patient populations (Holden *et al.,* 2011; Prados-Torres *et al.,* 2012; Prados-Torres *et al.,* 2014). For example, both cardiovascular and chronic pain morbidity were identified as the most prevalent domains in primary care settings (Britt *et al.,* 2008); cardiovascular diseases, metabolic conditions and

osteoarthritis are among the six most prevalent diseases within multimorbidity patterns (Violan *et al.,* 2014); and chronic low back pain and depression had the strongest association in clustering with other diseases (Schäfer *et al.,* 2014). Moreover, mental health and musculoskeletal disorders tend to cluster together with pain symptoms, whereas substance and alcohol abuse cluster with both cardiovascular disease and mental health disorders. Finally, mental health disorders (Prados-Torres *et al.,* 2014) and a pain-related cluster, including migraine, neck, back, and other pains, was recently described in a working population (Holden *et al.,* 2011). Less clear are the causal pathways involved in how different health conditions cluster and evolve over time, and this should be further explored.

5.1.3 Severity of health-related conditions

When measuring the burden of multimorbidity, the severity of the heath conditions can be determined either by considering its contribution to the overall multimorbidity pattern, or its association with poor self-perceived general health status.

Within multimorbidity patterns, contributions of relevant health-related conditions to the internal variability of each pattern were considered as severity-weights. For example, while in men hyperlipidemia and hypertension contributed the most to the cardiovascular pattern, peripheral vascular and cerebrovascular disease did so for women. Neck and low back pain accounted for most of the severity-weight within the pain symptom pattern in both sexes. In contrast, severity weights for Dutch workers were calculated for each diagnosis group by

examining their impact on poor general health status, considering sex, age and health-related behaviors, through the self-reported single item question of the 36-item Short-Form Health Survey (SF-36). Musculoskeletal disorders were the most common self-reported chronic condition with the greatest impact on poor health.

5.1.4 Multimorbidity and sickness absence

Multimorbidity predicted risk of overall and diagnosis-specific sickness absence incidence in men and women, even after accounting for prior sickness absence. In contrast, it had little, if any, effect on sickness absence duration. High levels of multimorbidity were associated with a higher risk of both overall and diagnosis-specific sickness absence.

Prior sickness absence has been found to be a strong predictor of risk of future episodes (Roelen *et al.*, 2011) as it was in our study. However, the presence of multimorbidity added predictive value, especially among those without prior sickness absence episodes.

The effect on incidence was notable among men, those with a high level of multimorbidity, in the absence of a prior sickness absence episode and in all three diagnosis-specific groups, especially cardiovascular diseases. The latter was possibly due in part to the number of questionnaire items devoted to cardiovascular conditions and risk factors, but with fewer centering on other high-cost chronic conditions (e.g., mental disorders, musculoskeletal, respiratory diseases or tumors). Despite this, associations were still found between high

multimorbidity and risk of new sickness absence episodes due to musculoskeletal and mental disorders, the latter being especially strong among women. Our findings are generally in agreement with the limited previous literature (Kessler *et al.,* 2001; Boot *et al.,* 2011) and are relevant to working populations given that, as a result of aging, in addition to people working longer, the prevalence of chronic conditions is gradually increasing, affecting 40% of the Western workforce, regardless of occupation (Bevan *et al.,* 2009).

We did not find a significant effect on duration of sickness absence episodes. In addition to health-related conditions, many other factors influence time to return to work of workers with chronic diseases, including job demands, workplace environment (psychosocial and organizational factors) and personal factors (e.g., age, gender, educational level and self-prediction of returning to work) (Abma *et al.,* 2013b; Koolhaas *et al.,* 2014; Vooijs *et al.,* 2015b). When comparing workers with and without chronic conditions, the type of obstacles and needs do not differ, suggesting that work-related factors are more related to these limitations and needs than the chronic condition itself (Koolhaas *et al.,* 2013). Unfortunately, aside from occupational social-class, we were unable to assess the effects of these other work-related variables, as they were not available. As mentioned earlier, some degree of selection bias towards the healthiest workers may have underestimated not only the prevalence of multimorbidity, but also the incidence and duration of sickness absence in our population. In fact, the overall 2-year incidence in our sample (8%) was much lower than the annual incidence (25%) of sickness absence in Spain in 2006

(Benavides *et al.,* 2013). All in all, multimorbidity together with prior sickness absence episodes, can be considered a comprehensive construct of general health status that, in turn, affects the relationship between work and health.

5.1.5 Work functioning trajectories and multimorbidity

We were also interested in using trajectory modeling to identify meaningful relationships between coexisting chronic conditions and work functioning trajectories after returning to work following an absence due to a common mental disorder. We identified four different groups of workers that followed similar work functioning trajectories in the year following their return to work. Three of these trajectories (accounting for 88% of the study population) were stable over the course of the follow-up period, but one (representing the remaining 12%) showed increasing work functioning scores. A worrying finding was that few workers, only one in four, belong to the high stable work functioning trajectory.

Overall, the study population had relatively high scores on some mental health measures and lower mean work functioning scores compared to a healthy population (Abma *et al.,* 2013a), despite showing some improvement over time (Arends *et al.,* 2014). In the Netherlands, return to work is often a gradual process, guided by assessment and agreement among occupational physicians, employers and employees (Klink 2007). It is conceivable that some workers returned to work with some reduction in symptoms, but still not ready to fully perform at work.

Although recent studies have found early return to work is beneficial in increasing work participation (Kausto *et al.,* 2014), and that symptom recovery seems not to impact return to work(de Vente *et al.,* 2015) , the effect of early return to work on the relationship between remaining complaints and the ability to perform at work has not been fully addressed and deserves more attention.

The usefulness of applying this group-based trajectory modeling methodology to examine occupational outcomes, such as work functioning, is that it allows tracking how these outcomes evolve over time from an individual-centered rather than variable-centered perspective. This enables identification of the percentages of individuals following different trajectories in the data (Strauss *et al.,* 2014; Veldman *et al.,* 2015). Analyzing work functioning trajectories after return to work may help identify workers who need support to stay at work and to develop appropriate interventions.

Although we found baseline multimorbidity did not influence the probability of belonging to a specific work functioning trajectory after return to work, most of the workers in the high stable trajectory had no multimorbidity. Baseline multimorbidity was related to decreased work functioning after return to work, but had no effect on those trajectories that were stable over time. However, among workers whose work functioning improved over time, this improvement was dampened by higher baseline multimorbidity. In the high stable trajectory, it could be that those workers who had better mental health were more adapted to their chronic conditions and coped with their multimorbidity without

affecting work functioning. In contrast, in the low and medium stable trajectories, the lower work functioning scores may be the result of poorer mental health, to the point that multimorbidity might not have had an additional effect.

5.2 METHODOLOGICAL CONSIDERATIONS

Our results should be interpreted taking into account several additional considerations, both limitations and strengths.

The data came from only one public health insurance company (*mutua*), albeit one of the largest in Spain (overall mean insured population in 2006 was 980,463 workers) with representation throughout the various country regions, where healthcare coverage is comparable to other western European Union countries (Figueras *et al.,* 2008). Although, overall, the proportion of men (60%) and women (40%) insured by the *mutua* was representative of the Spanish working population during the study period (Instituto Nacional de Estadística, 2007), women (roughly 30%) were underrepresented in our study. Together with the generally low prevalence of multimorbidity among women, this may have affected the consistency of our results with previous evidence. A reason that could explain the lower participation of women in our study might be their greater adherence to medical visits in primary care and specialized settings. Women might be less likely to undergo workplace-based medical evaluations since a large part of routine female examinations are gynecologic in nature. In the general population, women tend to have more visits to family practitioners and are more

likely to report health-related symptoms and poor self-perceived health than men (Carretero *et al.,* 2014). Moreover, the healthy worker survivor effect may have led to greater out-selection of less healthy workers among women than men. Nonetheless, the working population was appropriate as a target for our study aim and our findings are, at a minimum, likely to be relevant to other similar working populations.

Another limitation relates to the use of questionnaire-based data. The data had been previously collected, but were not originally designed to study multimorbidity. Thus, we may have underestimated the prevalence of health conditions, behaviors, and other morbidities not measured in this study. However, by including symptoms (e.g., pain and sleep disturbances) as a dimension of disease, some of these other common pathologies may have been indirectly captured (e.g., mental, musculoskeletal disorders).

Regarding multimorbidity, being a working population, our participants were relatively younger than the general population, and their morbidities and health behaviors are likely to fluctuate more over time. In a workforce, chronic diseases are not as prevalent as in other more commonly studied populations, whereas unhealthy behaviors leading to later development of chronic conditions are (Miller, 2011). The development of multimorbidity is a dynamic phenomenon that evolves over time (Prados-Torres *et al.,* 2012), but good prospective studies on multimorbidity are lacking. Even so, distinct trajectories of multimorbidity in primary care patients have been recently described

after 3 years of follow-up (Strauss *et al.,* 2014). Our study design had only a baseline measurement of multimorbidity, which precluded examining temporal changes in the relationship between MDMS and SA. Our two follow-up periods were short (two years post-exam for the Spanish studies and 12 months for the Dutch study), making it less likely for the MDMS to have changed much. Regardless, this would be better addressed using a repeated measures or other longitudinal design.

In contrast to indices of comorbidity (e.g., Charlson Index), useful for interventions at the individual clinical level (D'Hoore *et al.,* 1996), the MDMS is more appropriate for predicting health-related outcomes in populations. Although our results could conceivably have clinical significance, given the early stage of our research, it is premature to assert how clinically useful the MDMS would be.

We had no information on chronic conditions or sickness absence for workers who did not undergo the 2006 medical evaluation. Thus, since some of those may have been on sick leave, we may have underestimated both prevalence of multimorbidity and risk of sickness absence. Selection bias could have been present since we only included the first SA episode that emerged during the follow up, and this may have limited our interpretation of how duration evolves due to the influence of new or recurring episodes. Further longitudinal studies should consider absence trajectories when estimating the effect of multimorbidity on SA duration.

Sample size in our study of Dutch workers was somewhat small, although statistical significance was not the primary aim. Rather, we were more interested in using trajectory modeling to identify meaningful relationships between coexisting chronic conditions and work functioning trajectories. As noted above, the 12-month follow-up may have been too short to fully examine the effects of multimorbidity over time; in this regard, multiple measurements of multimorbidity over a longer period could be useful. Furthermore, due to loss to follow up (33%), some bias may have been introduced if lost workers were more or less likely to show the effect of multimorbidity on work functioning.

Although the Dutch version of the WRFQ has been shown to be both valid and reliable (Abma *et al.,* 2012), its responsiveness (sensitivity to change) has yet to be assessed, so changes in work functioning over time may not have been fully captured. This might explain our finding of three out of four stable work functioning trajectories, although one clearly showed a change over time.

Information on other workplace factors, such as organizational factors, was not available, and may have confounded or modified the effect of the associations observed. These factors could have allowed assessment, for example, of whether work-related factors are linked more to health-related limitations at work than multimorbidity itself (Koolhass, 2013), either alone or clustering with the CMD diagnosis.

There are also multiple strengths in these three studies. Collectively, they represent a novel starting point from which one can approach the role of multiple chronic conditions, including health-related behaviors and symptoms, on work functioning. The geographic areas covered in both Spain and the Netherlands were large, and there was variety in company size and economic sectors. Few previous studies have considered the effect of multiple coexisting chronic conditions on occupational outcomes such as work performance (Collins *et al.,* 2005), and none have focused on the course of work functioning over time.

Finally, in both study populations chronic conditions were identified by self-report, but not confirmed clinically (e.g., physician diagnosis) (Preen *et al.,* 2004). However, the predictive accuracy of self-reported morbidity as the basis for an index of chronic conditions has been previously validated in health interview surveys (Rius *et al.,* 2008). We were not able to use the proposed methodologies to apply the MDMS calculations and measure its predictive ability for SA and work functioning in other worker populations. Future research should be conducted with different datasets to both replicate our findings and further examine the generalizability of the proposed multimorbidity scores.

5.3 IMPLICATIONS FOR POLICY AND PRACTICE

- Population aging translates into a large health and economic burden, with great socioeconomic impact for labor market, healthcare and social security systems. A shift in healthcare systems is needed towards a more holistic patient-centered approach that improves prevention and management of outcomes related to chronic conditions.

- Aside from social policies, services and infrastructures should promote and accommodate sustainable employment among aging workers. There is a need to promote work functioning at the worksite by adjusting it to the needs of aging workers, who may be more vulnerable to the labor process.

- Employers, human resources managers, supervisors and workers have a shared responsibility to consider accommodations needed to maintain a healthy and sustainable stay at work or a successful return to work, especially for aging workers. This would translate into better health and quality of life, work retention, work functioning, competitiveness and work ability, as well as a lower risk of unemployment.

- Health care professionals, in coordination with employers and workers, are responsible for guiding individualized treatment and case management that favor a healthy and safe return to work following a sick leave.

- Labor markets, healthcare systems, regulations and economic policies should create a more favorable societal context for the relationship between health and the workplace. Policy and regulations should be balanced with the needs and challenges of an aging workforce in order to boost individual work ability, productivity and work participation.

- Measuring multimorbidity in working population may have useful implications for health surveillance and preventive practice. For example, identifying and following workers coping with health-related limitations at work could enable the design of more tailored workplace interventions. Likewise, it could help identify workers early on who are at risk of future sickness absence (primary prevention), those who experience delayed return to work (secondary prevention) or those who have returned to work and may still need special attention (tertiary prevention). In addition, future sickness absence episodes and associated costs among workers with multimorbidity could be much better projected.

- The workplace can be an ideal setting to design, implement and evaluate early health promotion programs for workers, aimed at delaying the onset of chronic conditions by preventing and/or reducing the prevalence of health-related risk factors.

- The design of return to work programs could benefit from incorporating measures to detect and better manage factors related to decreased work functioning in workers with multimorbidity.

5.4 FUTURE RESEARCH

- Prospective longitudinal studies should consider sickness absence trajectories (e.g., recurrence of episodes) when estimating the effect of multimorbidity on sickness absence incidence and duration.

- Future research should investigate the effect of multimorbidity on episodes of sickness absence due other high disabling or limiting conditions, such as tumors or chronic respiratory diseases.

- Repeated measures and other longitudinal study designs are needed to fully examine temporal changes in multimorbidity and its relationship with work functioning and sickness absence in worker populations.

- Future studies should aim for high internal validity by bringing together information in individual clinical records (e.g., from primary and/or specialized medical care settings), social and work-related factors, as well as administrative sickness absence management data bases, in large representative samples of workers registered in social security systems.

- Prospective designs would also allow for better investigation of the bidirectional relationships between work and health. This could allow us to tease out the extent to which multimorbidity is causally related to decreasing work functioning and increased sickness absence or, conversely, whether inadequate working conditions precede the onset of multimorbidity and/or increasing unfavorable health-related behaviors.

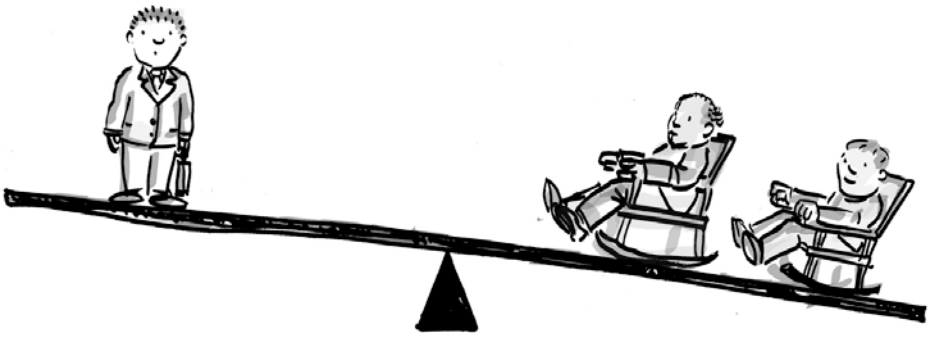
- Next steps will include applying our approach to multimorbidity in other populations, and determining its value by examining the degree to which it is able to predict various other outcomes. These outcomes should not be limited to indicators such as mortality or disease severity and their burden on the health care system, but also include the impact of multimorbidity as a potential determinant of ability to work, sick leave or quality of life.

6

Conclusions

You never get a point when you can say:
I´ve worked a lot and tomorrow is Sunday.
As soon as you finish, you start all over again.

~Pablo Ruiz Picasso



And…

In the end, it´s not the years in your life that count.
It´s the life in your years.

~Abraham Lincoln

.

6 CONCLUSIONS

1. Multimorbidity, together with prior sickness absence episodes, can be considered a comprehensive construct of general health status that, in turn, affects the relationship between work and health.

2. Measuring multimorbidity is challenging since prevalence estimates vary depending on the target population and the type and number of health-related conditions considered.

3. Rather than only including chronic conditions, a multidimensional multimorbidity measure (i.e., the MDMS) that combines chronic health conditions, health-related behaviors and symptoms, when applied to presumably younger, healthier working populations, is likely to be more sensitive in detecting a larger proportion of workers with at least one morbidity.

4. Clinically logical relationships among health-related conditions revealed patterns of multimorbidity consistent with those previously found in older and patient populations (i.e., cardiovascular diseases, pain symptoms and sleep disturbances commonly associated with decreased mental health). Underlying common causal pathways involved in how different health conditions cluster and evolve over time should be further explored.

5. Severity of heath conditions, when measuring multimorbidity burden, can be determined either by considering its contribution to multimorbidity patterns or its association with poor self-perceived general health.

6. Multimorbidity predicted risk of overall and diagnosis-specific sickness absence incidence in men and women, even after accounting for prior sickness absence. In contrast, it had little, if any, effect on sickness absence duration.

7. High multimorbidity was associated with greater risk of both overall and diagnosis-specific sickness absence.

8. Analyzing work functioning trajectories after return to work may help identify workers who need support to stay at work and to develop appropriate interventions.

9. Among workers with improved work functioning after return to work over time, this improvement was dampened by higher baseline multimorbidity.

7

List of references

It always seems impossible until it's done

~Nelson Mandela.

7 LIST OF REFERENCES

Aarts S (2012) Multimorbidity in General Practice: Adverse Health Effects and Innovative Research Strategies. Universitaire Pers: Maastricht.

Aaviksoo E, Baburin a, Kiivet R (2013) Risk factors for sickness absence among Estonian employees. Occup Med (Lond) 63:156–9.

Abma F, Bültmann U, Varekamp I, van der Klink JJ (2013a) Workers with health problems: three perspectives on functioning at work. Disabil Rehabil 35:20–26.

Abma F, Amick III BC, van der Klink JJ, Bültmann U (2013b) Prognostic factors for successful work functioning in the general working population. J Occup Rehabil 23(2):162-9.

Abma FI, Amick BC, Brouwer S, *et al.* (2012) The cross-cultural adaptation of the Work Role Functioning Questionnaire to Dutch. Work 43:203–210.

Agborsangaya CB, Ngwakongnwi E, Lahtinen M, *et al.* (2013) Multimorbidity prevalence in the general population: the role of obesity in chronic disease clustering. BMC Public Health 13:1161.

Amick BCI, Gimeno D (2008) Measuring work outcomes with a focus on health-related work productivity loss. Elsevier: Amsterdam.

Amick BC, Lerner D, Rogers W, *et al.* (2000) A review of health-related work outcome measures and their uses, and recommended measures. Spine, 25(24), 3152-3160.

Arends I, Bruinvels DJ, Rebergen DS, *et al.* (2012) Interventions to facilitate return to work in adults with adjustment disorders. Cochrane

Database Syst Rev 12.

Arends I, van der Klink JJ, Bültmann U (2010) Prevention of recurrent sickness absence among employees with common mental disorders: design of a cluster-randomised controlled trial with cost-benefit and effectiveness evaluation. BMC Public Health 10:132.

Arends I, van der Klink JJL, van Rhenen W, *et al.* (2014) Prevention of recurrent sickness absence in workers with common mental disorders: results of a cluster-randomised controlled trial. Occup Environ Med 71:21–9.

Baanders AN (2002) Labour participation of the chronically ill: A profile sketch. Eur J Public Health 12:124–30.

Barnett K, Mercer SW, Norbury M, *et al.* (2012) Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet 380:37–43.

Bayliss EA, Ellis JL, Shoup JA, *et al.* (2012) Association of patient-centered outcomes with patient-reported and ICD-9-based morbidity measures. Ann Fam Med 10:126–33.

Benavides F (2006) Ill health, social protection, labour relations, and sickness absence. Occup Environ Med 63:228-9.

Benavides F, Boix P, Rodrigo F, Gil J (Coordinadores) (2013) Informe de Salud Laboral, España 2001-2010.Barcelona: CISAL-UPF. Available from: https://www.upf.edu/cisal/_pdf/2013_05_ISL_2001-2010_ok_.pdf. Accessed 15 January 2016.

Benavides FG, Plana M, Serra C, *et al.* (2007) Incapacidad temporal por contingencia común: papel de la edad, el sexo, la actividad económica

y la comunidad autónoma. Rev Esp Salud Publica 81:183–90.

Bevan S, McGee R, Quadrello T, *et al.* (2009) Fit for work. Musculoskeletal Disorders in the European Workforce. The Work Foundation: London. Available from

http://www.fitforworkeurope.eu/Downloads/Website-Documents/Fit_for_Work_pan-European_report.pdf. Accessed 12 February 2016.

Boot CRL, Koppes LLJ, van den Bossche SNJ, *et al.* (2011) Relation between perceived health and sick leave in employees with a chronic illness. J Occup Rehabil 21:211–9.

Boot CRL, van den Heuvel SG, Bültmann U, *et al. (*2013) Work adjustments in a representative sample of employees with a chronic disease in the Netherlands. J Occup Rehabil 23:200–8.

Booth H, Prevost A, Gulliford M (2014) Impact of body mass index on prevalence of multimorbidity in primary care: cohort study. Family practice 31(1):38-43.

Börsch-Supan A, Brandt M, Hunkler C, *et al.* (2013a) Data resource profile: The survey of health, ageing and retirement in Europe (SHARE). Int J Epidemiol 42:992–1001.

Börsch-Supan A, Brandt M, Litwin H, Weber G (2013b) Active ageing and solidarity between generations in Europe: First results from SHARE after the economic crisis. Walter de Gruyter. Available from: http://www.degruyter.com/view/product/185064. Accessed 10 February 2016.

Börsch-Supan A, Kneip T, Litwin H, *et al.* (2015) Ageing in Europe-

Supporting Policies for an Inclusive Society. Walter de Gruyter. Available from:

http://www.degruyter.com/view/product/462442?rskey=FGKun7. Accessed 10 February 2016.

Boyd CM, Boult C, Shadmi E, *et al.* (2007) Guided Care for Multimorbid Older Adults. Gerontologist 47:697-704.

Britt HC, Harrison CM, Miller GC, Knox SA (2008) Prevalence and patterns of multimorbidity in Australia. Med J Aust 189:72–7.

Carretero M, Calderón-Larrañaga A, Poblador-Plou B, Prados-Torres A (2014) Primary health care use from the perspective of gender and morbidity burden. BMC Womens Health 14:145.

Casimirri E, Vaccari A, Schito M, *et al.* (2014) Chronic diseases are strongly associated with sickness absences in a sample of Italian public employees. Int J Occup Med Environ Health 27:343–54.

Collins JJ, Baase CM, Sharda CE, *et al.* (2005) The assessment of chronic health conditions on work performance, absence, and total economic impact for employers. J Occup Environ Med 47:547–57.

Cornell JE, Pugh JA, Williams Jr JW, *et al.* (2009) Multimorbidity clusters: clustering binary data from multimorbidity clusters: clustering binary data from a large administrative medical database. Appl Multivar Res 12:163–82.

Couch KA, Placzek D (2010) Earnings Losses of Displaced Workers Revisited. Am Econ Rev 100:572–89.

D'Hoore W, Bouckaert A, Tilquin C (1996) Practical considerations on the use of the Charlson comorbidity index with administrative data bases.

J Clin Epidemiol 49:1429–33.

de Vente W, Kamphuis JH, Blonk RWB, Emmelkamp PMG (2015) Recovery of Work-Related Stress: Complaint Reduction and Work-Resumption are Relatively Independent Processes. J Occup Rehabil 25:658–68.

Delclós J, García S, López J, *et al.* (2010) Duración de la incapacidad temporal por contingencia común por grupos diagnósticos. Arch Prev Riesgos Labor 13(4), 180-7.

Diederichs C, Berger K, Bartels DB (2011) The measurement of multiple chronic diseases—a systematic review on existing multimorbidity indices. Journals Gerontol Ser A Biol Sci Med Sci 66:301–11.

Durand M, Vachon B (2004) The cross-cultural adaptation of the work role functioning questionnaire in Canadian French. Int J Rehabil Res 27(4), 261-8.

Eurofound (2010) Absence from work. Eurofound: Dublin. Available from: http://www.eurofound.europa.eu/sites/default/files/ef_files/docs/ewco/tn0911039s/tn0911039s.pdf. Accessed 10 February 2016.

European Commission (2012) New skills and jobs in Europe: Pathways towards full employment. European Commission: Brussels. Available from: http://ec.europa.eu/research/social-sciences/pdf/new-skils-and-jobs-in-europe_en.pdf. Accessed 10 February 2016.

Feinstein AR (1970) The pre-therapeutic classification of co-morbidity in chronic disease. J Chronic Dis 23:455–68.

Figueras J, McKee M, Lessof S, *et al.* (2008) Health systems, health and wealth: assessing the case for investing in health systems. WHO,

Copenhagen. Available from:

http://www.euro.who.int/__data/assets/pdf_file/0009/83997/E93699.pdf. Accessed 21 February 2016

Fortin M, Haggerty J, Almirall J, *et al.* (2014) Lifestyle factors and multimorbidity: a cross sectional study. BMC Public Health 14:686.

Fortin M, Lapointe L, Hudon C, *et al.* (2004) Multimorbidity and quality of life in primary care: a systematic review. Health Qual Life Outcomes 2:51.

Fortin M, Soubhi H, Hudon C, *et al.* (2007) Multimorbidity's many challenges. BMJ 334:1016.

Fortin M, Stewart M, Poitras M, Maddocks H (2012) A Systematic Review of Prevalence Studies on Multimorbidity : Toward a More Uniform Methodology. Ann Fam Med 10(2): 142–51.

Gérvas J, Ruiz-Téllez A, Pérez-Fernández M (2006) La incapacidad laboral en su contexto médico: problemas clínicos y de gestión. Madrid: Fundación Alternativas. Available from: http://www.seg-social.es/prdi00/groups/public/documents/binario/51588.pdf. Accessed 30 January 2016.

Gimeno D, Benavides FG, Amick BC, *et al.* (2004) Psychosocial factors and work related sickness absence among permanent and non-permanent employees. J Epidemiol Community Health 58:870–6.

Gimeno D, Bültmann U, Benavides FG, *et al.* (2014) Cross-national comparisons of sickness absence systems and statistics: Towards common indicators. Eur J Public Health 24 (4):63-6.

Greß S, Baan CA, Calnan M, *et al.* (2009) Co-ordination and management of

chronic conditions in Europe: the role of primary care–position paper of the European Forum for Primary Care. Qual Prim Care 17(1):75-86.

Guthrie B, Watt G, Wyke S, Mercer SW (2012) Epidemiology of multimorbidity – Authors' reply. Lancet 380:1383–4.

Hoefsmit N, Houkes I, Nijhuis FJN (2012) Intervention characteristics that facilitate return to work after sickness absence: A systematic literature review. J Occup Rehabil 22:462–77.

Holden L, Scuffham PA, Hilton MF, *et al.* (2011) Patterns of multimorbidity in working Australians. Popul Health Metr 9:15.

Huntley AL, Johnson R, Purdy S, *et al.* (2012) Measures of Multimorbidity and Morbidity Burden for Use in Primary Care and Community Settings : A Systematic Review and Guide. 134–41.

Ilmarinen JE (2001) Aging workers. Occup Environ Med 58:546.

International Labour Office (2014) Global employment trends 2014: Risk of a jobless recovery? International Labour Organization: Geneva. Available from: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_233953.pdf. Accessed 15 February 2016.

Instituto Nacional de Estadística. (2007) Encuesta de Población Activa (EPA). Cuarto trimestre del 2006. Available from: http://www.ine.es/daco/daco42/daco4211/epa0406.pdf. Accessed 10 January 2016.

Jones MK, Latreille PL, Sloane PJ, Staneva A V (2013) Work-related health

risks in Europe: are older workers more vulnerable? Soc Sci Med 88:18–29.

Kausto J, Viikari-Juntura E, Virta LJ, *et al.* (2014) Effectiveness of new legislation on partial sickness benefit on work participation: a quasi-experiment in Finland. BMJ Open 4:e006685–e006685.

Kessler RC, Greenberg PE, Mickelson KD, *et al.* (2001) The effects of chronic medical conditions on work loss and work cutback. J Occup Environ Med 43:218–25.

Klink J van der (2007) Richtlijn: Handelen van de bedrijfsarts bij werkenden met psychische problemen. [Guideline: Management of mental health problems of workers by occupational physicians]. NVAB [Netherlands Society of Occupational Medicine]: Utrech.

Kohli M, Rosenow J, Wolf J (1983) The Social Construction of Ageing through Work: Economic Structure and Life-world. Ageing Soc 3:23–42.

Koolhaas W, van der Klink JJL, de Boer MR, *et al.* (2014) Chronic health conditions and work ability in the ageing workforce: the impact of work conditions, psychosocial factors and perceived health. Int Arch Occup Environ Health 87:433–43.

Koolhaas W, van der Klink JJL, Vervoort JPM, *et al.* (2013) In-depth study of the workers' perspectives to enhance sustainable working life: comparison between workers with and without a chronic health condition. J Occup Rehabil 23:170–9.

Koskela R, Korhonen H, Jarvinen E (1984) Different stages of disease, changes in heaviness of work and life cycle. Scand J Work Environ Health 10(6), 451-4.

Lerner D, Allaire SH, Reisine ST (2005) Work Disability Resulting From Chronic Health Conditions. J Occup Environ Med 47:253–64.

Lerner DJ, Amick BC, Malspeis S, Rogers WH (2000) A national survey of health-related work limitations among employed persons in the United States. Disabil Rehabil 22:225–32.

Li C-Y, Sung F-C (1999) A review of the healthy worker effect in occupational epidemiology. Occup Med 49:225–9.

Loeppke R, Edington DW, Bég S (2010) Impact of the prevention plan on employee health risk reduction. Popul Health Manag 13:275–84.

Marengoni A, Angleman S, Melis R, *et al.* (2011) Aging with multimorbidity: A systematic review of the literature. Ageing Res Rev 10:430–9.

Marmot M, Feeney A, Shipley M, *et al.* (1995) Sickness absence as a measure of health status and functioning: from the UK Whitehall II study. J Epidemiol Community Health 49:124–30.

Mastekaasa A (2000) Parenthood, gender and sickness absence. Soc Sci Med 50:1827–42.

Mastekaasa A (2005) Sickness absence in female- and male-dominated occupations and workplaces. Soc Sci Med 60:2261–72.

Mathers C, Fat D & Boerma J (2008). The global burden of disease: 2004 update. World Health Organization: Geneva. Available from: http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf. Accessed 10 January 2016.

Miller S (2011) Declining health of U.S. workers is driving up employer costs. In: Society for Human Resource Management.. Available from: https://www.shrm.org/hrdisciplines/benefits/Articles/Pages/Declin

ingHealth.aspx. Accessed 10 January 2016.

Ministerio de Empleo y Seguridad Social. Gobierno de España Estadísticas, presupuestos y estudios. Available from: http://www.seg-social.es/Internet_1/Estadistica/Est/Otras_Prestaciones_de_la_Seguridad_Social/Incapacidad_Temporal/index.htm. Accessed 19 January 2016.

Nagel G, Peter R (2008) The impact of education on risk factors and the occurrence of multimorbidity in the EPIC-Heidelberg cohort. BMC Public Health 8(1): 1.

OECD (2015) OECD Employment Outlook 2015. OECD Publishing, Paris. Available from http://dx-doi.org/10.1787/empl_outlook-2015-en. Accessed 10 January 2016.

OECD (2009) Sickness, disability and work. Keeping on Track in the Economic Downturn: Background Paper. Available from: http://www.oecd.org/els/emp/42699911.pdf. Accessed 10 January 2016.

Ohayon MM (2002) Epidemiology of insomnia: what we know and what we still need to learn. Sleep Med Rev 6:97–111.

Parekh A, Kronick R, Tavenner M (2014) Optimizing health for persons with multiple chronic conditions. JAMA 312(12), 1199-200.

Pikó B, Barabás K, Boda K (1997) Frequency of common psychosomatic symptoms and its influence on self-perceived health in a Hungarian student population. Eur J Public Health 7:243–7.

Prados-Torres A, Calderón-Larrañaga A, Hancco-Saavedra J, *et al.* (2014) Multimorbidity patterns: a systematic review. J Clin Epidemiol

67:254–66.

Prados-Torres A, Poblador-Plou B, Calderón-Larrañaga A, *et al.* (2012) Multimorbidity patterns in primary care: interactions among chronic diseases using factor analysis. PLoS One 7:e32190.

Preen DB, Holman CJ, Lawrence DM, *et al.* (2004) Hospital chart review provided more accurate comorbidity information than data from a general practitioner survey or an administrative database. J Clin Epidemiol 57:1295–304.

Quintini G, Venn D (2013) Back to Work: Re-employment, Earnings and Skill Use after Job Displacement. Available from: http://www.oecd.org/els/emp/Backtowork-report.pdf. Accessed 5 February 2016.

Ramada J, Delclos G, 3rd BA (2014) Sensibilidad al cambio del Cuestionario de Desempeño del Trabajo (versión española) en una población trabajadora. Arc Preven Riesgos Laborales 17(2), 105-7.

Ramada JM, Serra C, Amick III BC, *et al.* (2013) Cross-Cultural Adaptation of the Work Role Functioning Questionnaire to Spanish Spoken in Spain. J Occup Rehabil 23:566–75.

Rius C, Pérez G, Rodríguez-Sanz M, Fernàndez E (2008) Comorbidity index was successfully validated among men but not in women. J Clin Epidemiol 61:796–802.

Robson WBP (2001) Aging populations and the workforce: Challenges for employers. British-North American Committee Washington, DC. Available from:

https://www.cdhowe.org/pdf/bnac_aging_populations.pdf.

Accessed 12 January 2016.

Roelen CAM, Koopmas PC, Schreuder J AH, *et al.* (2011) The history of registered sickness absence predicts future sickness absence. Occup Med 61:96-101.

Rogers M, Hagberg J (1990) Decline in VO2max with aging in master athletes and sedentary men. Journal of Applied Physiology 68(5), 2195-99.

Sabbati G (2013a) Ageing Population: Projections 2010-2060 for the EU27. In: European Parliament Think Tank. Available from: http://epthinktank.eu/2013/12/19/ageing-population-projections-2010-2060-for-the-eu27/. Accessed 20 February 2016.

Salisbury C, Johnson L, Purdy S, *et al.* (2011) Epidemiology and impact of multimorbidity in primary care: a retrospective cohort study. Br J Gen Pract 61:e12.

Salive ME (2013) Multimorbidity in older adults. Epidemiol Rev 35:75–83.

Sampere M, Gimeno D, Serra C (2011a) Effect of working conditions on non-work-related sickness absence. Occup Med (London) 62:60-3.

Sampere M, Gimeno D, Serra C, *et al.* (2011b) Return to Work Expectations of Workers on Long-Term Non-Work-Related Sick Leave. J Occup Rehabil 22(1):15-26.

Schäfer I, Kaduszkiewicz H, Wagner H-O, *et al.* (2014) Reducing complexity: a visualisation of multimorbidity by combining disease clusters and triads. BMC Public Health 14:1285.

Schäfer I, von Leitner E-C, Schön G, *et al.* (2010) Multimorbidity patterns in the elderly: a new approach of disease clustering identifies complex

interrelations between chronic conditions. PLoS One 5:e15941.

Smith SM, Ferede A, O'Dowd T (2008) Multimorbidity in younger deprived patients: An exploratory study of research and service implications in general practice. BMC Fam Pract 9:6.

Spirduso WW (1995) Job performance of the older worker. Physical dimensions of aging. Human Kinetics: Champaign (IL).

Starfield B (2011) Challenges to primary care from co-and multi-morbidity. Prim Health Care Res Dev 12:1–2.

Starfield B (2006) Threads and yarns: Weaving the tapestry of comorbidity. Ann Fam Med 4:101–3.

Strauss VY, Jones PW, Kadam UT, Jordan KP (2014) Distinct trajectories of multimorbidity in primary care were identified using latent class growth analysis. J Clin Epidemiol 67:1163–71.

Surís J-C, Michaud P-A, Akre C, Sawyer SM (2008) Health risk behaviors in adolescents with chronic conditions. Pediatrics 122:e1113–8.

Taylor A, Price K, Gill T, *et al.* (2010) Multimorbidity-not just an older person's issue. Results from an Australian biomedical study. BMC Public Health 10:718.

Tora Rocamora I, Martinez Martinez JM, Delclos Clanchet J, *et al.* (2010) Duración de los episodios de incapacidad temporal por contingencia común según regiones sanitarias en Catalunya. Rev Esp Salud Publica 84:61–9.

Tuomi K, Ilmarinen J, Klockars M, *et al.* (1997) Finnish research project on aging workers in 1981-1992. Scand J Work Environ Health 23:7–11.

Ubalde-Lopez M, Delclos GL, Calvo E, Benavides FG (2013) Influence of

new secondary diagnoses on the duration of non-work-related sickness absence episodes. J Occup Environ Med 55:460–4.

United Nations (2013) World Population Ageing 2013. UN, New York. Available from:

http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf. Accessed 10 January 2016.

Valderas JM, Starfield B, Sibbald B, *et al.* (2009) Defining comorbidity: implications for understanding health and health services. Ann Fam Med 7:357–63.

van den Akker M, Buntinx F, Knottnerus JA (1996) Comorbidity or multimorbidity: what's in a name? A review of literature. Eur J Gen Pract 2:65–70.

van den Akker M, Buntinx F, Metsemakers JF, *et al.* (1998) Multimorbidity in general practice: prevalence, incidence, and determinants of co-occurring chronic and recurrent diseases. J Clin Epidemiol 51:367–75.

Vaughan-Jones H (2009) Healthy Work: Challenges and Opportunities to 2030. British United Provident Association. Available from: http://www.theworkfoundation.com/assets/docs/publications/216_bupa_report.pdf. Accessed 8 January 2016.

Veldman K, Reijneveld SA., Almansa Ortiz J, *et al.* (2015) Mental health trajectories from childhood to young adulthood affect the educational and employment status of young adults: results from the TRAILS study. J Epidemiol Community Heal 69:588-93.

Violan C, Foguet-Boreu Q, Flores-Mateo G, *et al.* (2014) Prevalence,

determinants and patterns of multimorbidity in primary care: a systematic review of observational studies. PLoS One 9:e102149.

Violán C, Foguet-Boreu Q, Roso-Llorach A, *et al.* (2014) Burden of multimorbidity, socioeconomic status and use of health services across stages of life in urban areas: a cross-sectional study. BMC Public Health 14:530.

Violán C, Foguet-Boreu Q, Roso-Llorach A, *et al.* (2015) [Multimorbidity patterns in young adults in Catalonia: an analysis of clusters]. Aten Primaria. Advance online publication, 16 Dec 2015. Vooijs M, Leensen MCJ, Hoving JL, *et al.* (2015b) Disease-generic factors of work participation of workers with a chronic disease: a systematic review. Int Arch Occup Environ Health 88:1015–29.

Vuong TD, Wei F, Beverly CJ (2015) Absenteeism due to Functional Limitations Caused by Seven Common Chronic Diseases in US Workers. J Occup Environ Med 57:779–84

Wagner EH. (2000). The role of patient care teams in chronic disease management. BMJ 320(7234): 569-72.

Walker A, Taylor P (1998) Combating age barriers in employment: A European portfolio of good practice. Luxembourg: Office for Official Publications of the European Communities. Available from: http://bookshop.europa.eu/en/combating-age-barriers-in-employment-pbSX0597454/. Accessed 5 January 2016.

World Health Organization (1993) Aging and working capacity: report of a WHO study group (Vol. 835). World Health Organization: Geneva. Available from:

http://apps.who.int/iris/bitstream/10665/36979/1/WHO_TRS_83

5.pdf. Accessed 10 January 2016.

World Health Organization (2009) Global health risks: mortality and burden of disease attributable to selected major risks. World Health Organization, Geneva. Available from:

http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf. Accessed 12 January 2016.

World Health Organization (2015) World Report on Ageing and Health. World Health Organization: Geneva. Available from: http://www.who.int/ageing/publications/world-report-2015/en/. Accessed 10 February 2016.

World Health Organization (2002) Innovative Care for Chronic Conditions: Building Block for Action. World Health Organization: Geneva. Available from:

http://www.who.int/chp/knowledge/publications/icccglobalreport.pdf. Accessed 15 January 2016.

World Health Organization (1978) International classification of diseases: ninth revision, basic tabulation list with alphabetic index. World Health Organization: Geneva. Available from: www.cdc.gov/nchs/data/dvs/2006-Vol-I.pdf. Accessed 8 December 2015.

World Health Organization (2001) The world health report 2001. Mental Health: New Understanding, New Hope. Chapter 2: Burden of mental and behavioral disorders. World Health Organization: Geneva. Available from: http://www.who.int/whr/2001/en/whr01_en.pdf. Accessed 15 January 2016.

8

Appendices

8 APPENDICES

8.1 Appendix I: Ethical Approval

Informe del Comité Ético de Investigación Clínica

Doña Mª Teresa Navarra Alcrudo Secretaria del Comité Ético de Investigación Clínica Parc de Salut MAR

CERTIFICA

Que éste Comité ha evaluado el proyecto de investigación clínica nº 2012/4782/I titulado *"Evaluación del impacto del estado previo de salud en la incidencia y duración de la incapacidad temporal por contingencia común. Proyecto ESAL-IT"* propuesto por la Dra. Mònica Ubalde López de la Universitat Pompeu Fabra de Barcelona.

Y que considera que:

Se cumplen los requisitos necesarios de idoneidad del protocolo en relación con los objetivos del estudio y están justificados los riesgos y molestias previsibles para el sujeto.

La capacidad del investigador y los medios disponibles son apropiados para llevar a cabo el estudio.

El alcance de las compensaciones económicas que se solicitan está plenamente justificado.

Y que éste Comité acepta que dicho proyecto de investigación sea realizado en la Universitat Pompeu Fabra de Barcelona por la Dra. Mònica Ubalde López como investigador principal tal como recoge el ACTA de la reunión del día 10 de Julio de 2012.

Lo que firmo en Barcelona, a 4 de Septiembre de 2012

Firmado: .....
Doña Mª Teresa Navarra Alcrudo

CEIC – Parc de Salut MAR
Dr. Aiguader, 88 I 08003 Barcelona I Teléfon 93 316 06 77 I Fax 93 316 06 36
ceic-psmar@imim.es | www.parcdesalutmar.cat

Dra. Mònica Ubalde López
Universitat Pompeu Fabra
C/ Dr. Aigüader, 88. PRBB 1ª Plta.
Despatx 171.02.
08003 Barcelona

Benvolguda Dra. Ubalde,

El CEIC-Parc de Salut MAR una vegada avaluats els comentaris demanats del projecte de recerca núm. 2012/4782/I titulat *"Evaluación del impacto del estado previo de salud en la incidencia y duración de la incapacidad temporal por contingencia común. Proyecto ESAL-IT"*, li comunica que ha obtingut l'aprovació. Li adjuntem el certificat corresponent.

Cordialment,

COMITÈ ÈTIC D'INVESTIGACIÓ CLÍNICA
CEIC - PARC DE SALUT MAR

Mª Teresa Navarra Alcrudo
Secretaria CEIC – Parc de Salut MAR

Barcelona, a 5 de setembre de 2012

CEIC – Parc de Salut MAR
Dr. Aiguader, 88 | 08003 Barcelona | Telèfon 93 316 06 77 | Fax 93 316 06 36
ceic-psmar@imim.es | www.parcdesalutmar.cat

8.2 Appendix II: Medical evaluation questionnaire (2006)

HISTORIA CLINICA LABORAL

☐ *Archivar más de 5 años*

EXAMEN DE SALUD REALIZADO EN: NUMERO HISTORIA: _____

☐ 1.-*Centro Propio* ☐ 3.-*Centro Asociado*

☐ 2.-*Despacho* ☐ 4.-*Unidad Móvil Propia* ☐ 5.-*Unidad Móvil Asociada* FECHA: ___ /___ /_____

Motivo del reconocimiento: ☐ 1.- Nuevo Ingreso ☐ 2.- Periódico ☐ 3.- Tras ausencia por motivo salud ☐ 4.- Cambio de puesto de trabajo

DATOS SOCIALES

APELLIDOS:	NOMBRE:	D.N.I:
SEXO: ☐ Hombre ☐ Mujer	FECHA DE NACIMIENTO:	EDAD:
DIRECCIÓN:	CIUDAD:	TELÉFONO:
PROVINCIA:	D.P.:	N.A.F.:
EMPRESA:	ACTIVIDAD:	D.P.:
C.C.C.:	DIRECCIÓN:	

CARACTERÍSTICAS DEL EXAMEN DE SALUD

PRUEBAS: ☐ CV ☐ AUD ☐ ESP ☐ ECG ☐ CROMÁTICO ☐ FORIAS ☐ RX TORAX ☐ RX SENOS PARANASALES ☐ RX ARTICULAR

TIPO DE RECONOCIMIENTO:

☐ G1
☐ G2

EXPLORACIÓN:	☐ Neurológico	☐ Osteo muscular	☐ Rinoscopia	☐ Otros
ANALÍTICA:	☐ Básica	☐ Otros	☐ Última comida Hora/min.(/)	☐ Extracción Hora/min.(/)

OBSERVACIONES:

CON ANTECEDENTES FAMILIARES DE:

☐1001.**- No refiere antecedentes de interés.**

Antecedentes familiares de 1er. grado de enfermedad coronaria precoz ☐0002.**- SI** ☐0003.**- NO** ☐0004.**- NS/NC**

COMO ANTECEDENTES PERSONALES PATOLÓGICOS DE INTERÉS:

MÉDICOS:

QUIRÚRGICOS:

LABORALES:

☐0001.- **PERSONALES: No refiere antecedentes personales de interés**

☐2001.- **No refiere accidentes laborales o enfermedades profesionales previas**

Cardiopatia Coronaria	☐0005.- **SI**	☐0006.- **NO**	☐0007.- **NS/NC**
Enf. Cerebrovascular	☐0008.- **SI**	☐0009.- **NO**	☐0010.- **NS/NC**
Arteriopatia periférica	☐0011.- **SI**	☐0012.- **NO**	☐0013.- **NS/NC**
HTA	☐0014.- **SI**	☐0015.- **NO**	☐0016.- **NS/NC**
Dislipemia	☐0017.- **SI**	☐0018.- **NO**	☐0019.- **NS/NC**
Diabetes tipo I	☐0020.- **SI**	☐0021.- **NO**	☐0022.- **NS/NC**
Diabetes tipo II	☐0023.- **SI**	☐0024.- **NO**	☐0025.- **NS/NC**
Trombosis venosa o embolia pulmonar con anticoagulantes	☐0026.- **SI**	☐0027.- **NO**	☐0028.- **NS/NC**

VACUNACIONES PERIÓDICAS Y ALERGIAS:

☐3001.- Propias de la infancia	☐3002.- Gripe	☐3003.- Tétanos	☐3004.- Hepatitis A	☐3005.- Hepatitis B	☐3006.- Tuberculosis

OTRAS VACUNAS:

ALERGIAS:

☐3010.- Cromo	☐3012.- Polvo doméstico	☐3014.- Alimentarias	☐3016.- Polvos orgánicos
☐3011.- Níquel	☐3013.- Ácaros	☐3015.- Harinas	☐3017.- Látex

OBSERVACIONES:

HÁBITOS

TABACO: ☐4001.- Fumador ☐4002.- No fumador	**Comentario:**	
☐4003.- No fuma ni ha fumado nunca	☐4007.- Fuma ocasionalmente	☐4011.- Fuma más de 40 cigarrillos/día
☐4004.- Dejó de fumar hace menos de un año	☐4008.- Fuma entre 1 y 10 cigarrillos/día	☐4012.- Fuma puros
☐4005.- Dejó de fumar hace más de 1 año y menos de 3 años	☐4009.- Fuma entre de 11 y 20 cigarrillos/día	☐4013.- Fuma pipas
☐4006.- Dejó de fumar hace más de 3 años	☐4010.- Fuma entre 21 y 40 cigarrillos/día	

ALCOHOL:

Comentario:

VINO (VASOS/S):	*CERVEZA (VASOS/S):*	*LICOR (COPAS/S):*
☐4101.- No consume bebidas alcohólicas	☐4103.- Consumo de bebidas alcohólicas preferentemente en el fin de semana	☐4105.- Consumo importante diario de bebidas alcohólicas
☐4102.- Consumo ocasional de bebidas alcohólicas (menos de 1 vez semana)	☐4104.- Consumo moderado diario de bebidas alcohólicas	☐4106.- Fue consumidor de bebidas alcohólicas en el pasado pero no actualmente

OTROS HABITOS TÓXICOS:

Comentario:

ALIMENTACIÓN:

Comentario:

☐4201.- **Alimentación variada sin dieta**	☐4205.- Alimentación pobre en hidratos de carbono	☐4209.- Alimentación vegetariana
☐4202.- Alimentación hipocalórica para control de peso	☐4206.- Alimentación pobre en purinas	☐4210.- Alimentación macrobiótica
☐4203.- Alimentación hiposódica	☐4207.- Alimentación gastroprotectora	
☐4204.- Alimentación pobre en grasas	☐4208.- Alimentación hepatoprotectora	

EJERCICIO:

Comentario:

☐4301.- No realiza ejercicio físico ni deporte	☐4303.- Hace menos de 2 horas/semana de ejercicio
☐4302.- Hace más de 2 horas/semana de ejercicio	☐4304.- Practica habitual de ejercicio físico y deporte

SUEÑO:

Comentario:

☐4401.- **Duerme bien. Seis horas o más**	☐4405.- Se despierta varias veces en la noche
	☐4406.- Despertar temprano y no se vuelve a dormir

ODONTOLÓGICO:

Comentario:

☐4501.- Revisión odontológica habitual	☐4502.- Revisión odontológica ocasional	☐4503.- Nunca ha ido al odontólogo para higiene bucal

GINECOLÓGICO UROLÓGICO:

Comentario:

☐4601.- No ha realizado ningún control ginecológico	☐4603.- Controles ginecológicos preventivos esporádicos	☐4605.- Realiza controles Urológicos preventivos
☐4602.- Controles ginecológicos preventivos anuales	☐4604.- Controles ginecológicos semestrales	☐4606.- No realiza controles Urológicos preventivos

INTESTINAL:

Comentario:

☐4701.-**Hábito intestinal normal**	☐4703.-Diarrea habitual	☐4702.-Estreñimiento habitual	☐4704.-Hábito intestinal alternante

SITUACIÓN ACTUAL

☐5001.- **No refiere ninguna situación, patología o sintomatología que se relacione con su trabajo**	☐5011.- Sensación Febril	☐5021.- Disminución del apetito
☐5002.- **SENSACIÓN SUBJETIVA de buena salud**	☐5012.- Sensación de opresión torácica	☐5022.- Sensación de falta de aire ocasional
☐5003.- Sensación de buena salud pero preocupado por ella	☐5013.- Tos habitual (definir)	☐5023.- Vómitos habituales/ Nauseas
☐5004.- Sensación de salud deficiente. Cree estar enfermo	☐5014.- Dolor de cabeza habitual	☐5024.- Sensación de adormecimiento (localizar en observaciones)
☐5005.- Sensación de cansancio	☐5015.- Dolor en zona lumbar	☐5027.- Refiere sensación de disnea
☐5006.- Sensación de mareo	☐5017.- Ardor de estómago	☐5028.- Refiere dolor cervical
☐5007.- Sensación de vértigo habitual	☐5018.- Molestias al orinar	☐5010.- Perdida importante de peso
☐5008.- Sudoración excesiva generalizada	☐5019.- Alteración de la menstruación	☐5032.- Proceso respiratorio de vías altas

☐5009.- Prurito generalizado		☐5033.- Proceso respiratorio de vías bajas

OBSERVACIONES:

EN TRATAMIENTO CON:

☐5029.- Consumo ocasional de:
☐5030.- Consumo habitual diario de:
☐5031.- **No consumo habitual diario de medicamentos**

ANTI HIPERTENSIVO	HIPOLIPEMIANTE	INSULINA/ANTIDIABÉTICO ORAL	ANTIAGREGANTE	ANTITABACO
☐5040.- **SI**	☐5043.- **SI**	☐5046.- **SI**	☐5049.- **SI**	☐5052.- **SI**
☐5041.- **NO**	☐5044.- **NO**	☐5047.- **NO**	☐5050.- **NO**	☐5053.- **NO**
☐5042.- **NS/NC**	☐5045.- **NS/NC**	☐5048.- **NS/NC**	☐5051.- **NS/NC**	☐5054.- **NS/NC**

Aviso legal acerca del carácter confidencial de los datos médicos

De conformidad con la Ley Orgánica 15/1999, de 13 de diciembre de Protección de Datos de Carácter Personal, la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. C/ Argos 4-6, 28037 Madrid, le informa que tratará como responsable sus datos personales así como todos aquellos datos e informaciones que se generen como consecuencia de las evaluaciones, análisis y exámenes de salud que se le practiquen, y los que facilite su empresa, con la finalidad de llevar a cabo los servicios de vigilancia de la salud que su Empresa tiene contratados. Mediante la firma del presente documento Usted consiente expresamente la realización de dichos exámenes para la vigilancia de su salud y el tratamiento de sus datos y de los resultados de los mismos con las finalidades de vigilancia de la salud por la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. Siendo los datos obligatorios para los fines indicados, y no pudiendo prestarlos si no facilita sus datos personales o no consiente su tratamiento.

En cumplimiento de la obligación empresarial de colaborar con el Sistema Nacional de la Salud recogida en el artículo 23 de la Ley de Prevención de Riesgos Laborales, la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. debe colaborar con los servicios de Salud Pública para el diagnóstico, tratamiento y rehabilitación de enfermedades relacionadas con el trabajo, y con las Administraciones sanitarias competentes en la actividad de salud laboral que se planifique. Asimismo, debe colaborar con las Autoridades Sanitarias para proveer el Sistema de Información Sanitaria en Salud Laboral. Comunicándose por ello sus datos de carácter personal, relativos a la salud, a dichas Administraciones o Autoridades Sanitarias.

Igualmente, la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. le informa que de conformidad con el artículo 22.4 de la Ley de Prevención de Riesgos Laborales informará, al empresario y a las personas u órganos con responsabilidades en materia de prevención de la Empresa en la que presta servicios, de las conclusiones que se deriven de los exámenes efectuados en relación con la aptitud del trabajador para el desempeño del puesto de trabajo con la necesidad de introducir o mejorar las medidas de protección y prevención, a fin de que puedan desarrollar correctamente sus funciones en materia preventiva. A tal efecto, Usted consiente expresamente mediante la firma del presente documento que la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. suministre a las citadas personas u órganos las conclusiones relativas a su aptitud para el desempeño del puesto de trabajo, lo que en ningún caso implicará la comunicación de información médica de carácter personal que sea resultado de las actuaciones realizadas por la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. en materia de vigilancia de la salud a la Empresa en la que presta servicios, salvo que preste su consentimiento con carácter previo y expreso.

En este sentido, le informamos que el resultado del examen de salud practicado tendrá carácter confidencial y se enviará en sobre cerrado a través de la Empresa en la que presta servicios para que le haga entrega del mismo o por otro medio que se le indicará.

Así mismo la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. le informa de que en algunas ocasiones para llegar a un correcto diagnóstico y calificación del grado de aptitud, puede ser preciso la realización de determinadas pruebas diagnósticas y/o interconsultas médicas. Consintiendo la realización de estas pruebas, y el tratamiento de sus datos, en el momento que se le realizan. Así mismo la realización de las pruebas, no sus resultados, serán comunicados a su empresa, consintiendo esta entrega de información al firmar este documento, salvo que se oponga a dicha comunicación marcando la siguiente casilla [ ].

Sus datos de carácter personal procedentes de los exámenes de salud serán cedidos a IBERMUTUAMUR M.A.T.E.P.S.S. nº 274, Ramírez de Arellano 27, 28043 Madrid, con el fin de incorporarlos a su historia clínica creada por accidentes de trabajo, enfermedades profesionales y comunes (en los casos que correspondiera), para la prevención y el correcto diagnóstico médico sobre su salud en la asistencia sanitaria de sus enfermedades, pudiendo oponerse a esta cesión de datos, lo que imposibilitará la correcta prestación de los servicios de prevención y diagnóstico médico, y repercutirá en una fragmentada y parcial visión clínica de su estado por parte de IBERMUTUAMUR, marcando la siguiente casilla [ ].

Por otra parte y con la finalidad de ser utilizados con fines científicos en los diferentes Programas de Prevención que se desarrollan de forma conjunta con IBERMUTUAMUR M.A.T.E.P.S.S. nº 274, sus datos de carácter personal procedentes de los exámenes de salud serán cedidos a IBERMUTUAMUR M.A.T.E.P.S.S. nº 274 y al Servicio Médico de su empresa cuando participe en estos programas, con el ánimo de mejorar la salud de los trabajadores a través de actuaciones específicas sobre los factores de riesgo detectados a través de los exámenes de salud, pudiendo oponerse a estas cesiones de datos, marcando la siguiente casilla [ ].

Si lo desea, puede ejercitar sus derechos de acceso, rectificación, cancelación y oposición mediante escrito dirigido a la SOCIEDAD DE PREVENCIÓN DE IBERMUTUAMUR S.L.U. C/ Argos 4-6, 28037, Madrid.

Firma del trabajador:

EXPLORACIÓN				
PESO KG: TALLA (M.):	PERÍMETRO DE CINTURA (CM.) :	1.-T.MAX./MIN.: (/) 2.-T.MAX./MIN.: (/)	1.- FREC. CARDIACA: 2.- FREC. CARDIACA:	☐6999.- Rítmico ☐6000.- Arrítmico

DESARROLLO MUSCULAR:

☐6001.- **Desarrollo muscular normal**	☐6002.- Hipertrofia muscular	☐6003.- Hipotrofia muscular	☐6004.- Atrofia muscular (localizar)

COLORACIÓN PIEL Y MUCOSAS:

☐6005.- **Buena coloración piel y mucosas**	☐6007.- Coloración subictérica	☐6009.- Coloración negruzca de piel
☐6006.- Palidez de piel y mucosas	☐6008.- Acrocianosis	☐6010.- Coloración rubicunda de piel

HISTORIA LABORAL **EVALUACIÓN DE RIESGOS LABORALES ☐ SI ☐ NO**

PUESTO DE TRABAJO ACTUAL: *MESES:*

EXPOSICIÓN RIESGOS SUSCEPTIBLES DE VIGILANCIA DE LA SALUD:

☐011.- **Trabajos en altura**	☐310.- **Exposición a contaminantes químicos sin definir**	☐713.- **Cadmio**	☐350.- **Estrés Térmico**
☐130.- **Sobreesfuerzos**	☐701.- **Benceno**	☐950.- **Hidrocarburos aromáticos excepto benceno**	☐360.- **Radiaciones ionizantes categoría A**
☐131.- **Movimientos repetitivos**	☐702.- **Cloruro de metileno**	☐960.- **Hidrocarburos alifáticos**	☐361.- **Radiaciones ionizantes categoría B**
☐132.- **Manipulación manual de cargas**	☐703.- **Cloruro de vinilo**		☐370.- **Radiaciones no ionizantes**
☐133.- **Posturas forzadas**	☐704.- **Disolventes orgánicos**	☐314.- **Exposición a polvos y humos sin definir**	☐**390.- Compresión / descompresión**
☐140.- **Exposición a temperaturas ambientales extremas**	☐705.- **Isocianatos**	☐751.- **Harinas y sustancias de origen vegetal**	☐**410.- Carga física estática**
☐320.- **Exposición a contaminantes biológicos**	☐706.- **Xileno**	☐752.- **Maderas**	☐420.- **Carga física dinámica**
☐330.- **Ruido**	☐707.- **Plaguicidas**	☐753.- **Medicamentos**	☐450.- **Carga mental**
☐340.- **Vibraciones**	☐708.- **Citostáticos**	☐754.- **Polvo orgánico de proteínas animales y vegetales**	☐490.- **Carga/fatiga visual**
☐714.- **Agentes anestésicos inhalatorios**	☐709.- **Cromo**	☐755.- **Sílice**	☐510.- **Puestos de trabajo con pantallas de isualización**
☐715.- **Flúor**	☐710.- **Mercurio**	☐756.- **Amianto/Asbesto**	☐515.- **Exposición a ambiente interior (S.E.E.)**
	☐711.- **Plomo**	☐757.- **Carbón**	☐800.- **Trabajo en espacios confinados**
	☐712.- **Níquel**		☐850.- **Turnicidad**

OTROS RIESGOS (indicar códigos):

Puesto de trabajo anterior (1)	Riesgo/Tiempo exposición(meses):
Puesto de trabajo anterior (2)	Riesgo/Tiempo exposición(meses):
Puesto de trabajo anterior (3)	Riesgo/Tiempo exposición(meses):

Fdo.: Médico Reconocedor

Fdo.: D.U.E./Auxiliar

Dr./Dra. .....

D./Dña. .....

Nº Usuario ☐☐☐☐☐

Nº Usuario ☐☐☐☐☐

SEGUIMIENTO DEL PLAN DE PREVENCIÓN DEL RIESGO CARDIOVASCULAR

Teléfono de contacto: ..... ***Hora de contacto:*** .....

☐ ***NO QUIERE SEGUIMIENTO***

8.3 Appendix III: Conference communications

II Jornada científica CiSAL 2012. Organization: CISAL-UPF. Place: Barcelona, Spain. Date: May 2012.Type: Poster.

M Ubalde-López, J Delclós, E Calvo, F G Benavides. The duration of the long-term sickness absence episodes almost doubles when other diseases arise in their course.

The duration of the long-term sickness absence episodes almost doubles when other diseases arise in their course

M Ubalde-López [1], J Delclós [2,3,4], E Calvo [5], F G Benavides [2,4]

(1) Center for research in occupational health (CiSAL). Pompeu Fabra University. Barcelona. CiSAL PhD fellowship 2011-2012; (2) Center for research in occupational health (CiSAL). Pompeu Fabra University. Barcelona; (3) Southwest Center for Environmental and Occupational Health, University of Texas School of Public Health, Houston; (4) CIBERESP of Public Health;(5) Health Project Department. Ibermutuamur. Madrid.

a. Introduction

✓ **Sickness absence (SA)** is costly, representing around 0.7% of the gross domestic product, more than **8 billion** euros in Spain **in 2009.**

✓ Among the biological factors of SA duration, **comorbidities** would be expected to influence the SA duration. It may be pre-existing or may arise during the course of the SA absence. There has been **little research to date** with respect to the later.

OBJECTIVE

To describe the frequency and distribution of new diagnoses arising in the course of SA episodes (co-diagnoses), and to analyze their effect on duration of sickness absence in Spain.

b. Methods

Study population and design

✓ **Population base:** 632,000 workers covered by a Spanish mutua

✓ **Study period:** 2004 to 2007

✓ **Sample:** 15,246 SA closed episodes

✓ **Main Outcome variable**: SA episode duration

✓ **Main independent variables**: Initial diagnosis and co-diagnoses

✓ **Covariates**:

- ✓ Demographic :age, sex, educational level, autonomous region.
- ✓ Employment-related: benefits payment, average daily wage, seniority, economic activity, occupation.

Statistical analysis

✓ **Descriptive analysis**: SA duration expressed as median duration (MD), 25th (P25) and 75th(P75) percentiles.

✓ **Kaplan-Meier survival analysis**: probability of case closure by duration for each variable.

✓ **Cox survival analysis**: Hazard ratio (HR): instantaneous risk of case closure at any point of time.

HR>1 implies shorter duration

c. Results

• **Mental disorders, injuries and musculoskeletal** diseases were the most frequent diagnosis with any co-diagnosis arising during their course and also showed the longest durations (Table 1)

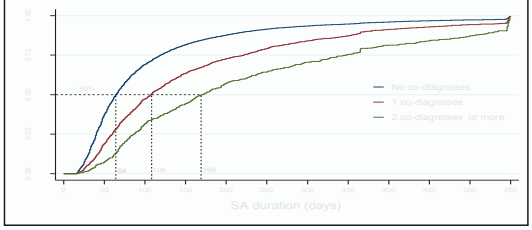
Table 1. Distribution and duration of sickness absence (SA) episodes by diagnostic groups and number of co-diagnoses.

DIAGNOSTIC GROUPS (ICD9)	Distribution and duration of sickness absence episodes (days)*							
	Overall		No co-diagnosis		1 co-diagnosis		≥ 2 co-diagnoses	
	N	P50 (P25;P75)	N	P50 (P25,P75)	N	P50 (P25,P75)	N	P50 (P25,P75)
Infectious and parasitic diseases	33	43 (33;76)	29	40 (28;60)	1	84 (84;84)	3	365 (60;547)
Neoplasms	393	72 (49;164)	320	68 (46;124)	51	97 (57;277)	22	118 (82;318)
Mental disorders	3917	109 (58;208)	3446	100 (54;187)	**344**	**168** (95;305)	**127**	**316** (139;499)
Nervous system and sense organ diseases	644	67 (42;127)	540	59 (40;104)	82	151 (86;352)	22	243 (165;272)
Circulatory system diseases	448	43 (32;67)	396	42 (32;62)	41	49 (37;109)	11	82 (46;194)
Respiratory system diseases	285	47 (32;81)	249	45 (30;70)	29	76 (46;152)	7	54 (36;101)
Digestive system diseases	2300	48 (37;71)	2038	47 (36;66)	206	64 (45;108)	56	102 (65;183)
Genitourinary system diseases	48	39 (26;70)	37	37 (25;58)	8	48 (27;70)	3	175 (101;534)
Pregnancy, childbirth and puerperium complicatior	1446	68 (42;109)	1273	65 (40;104)	124	85 (48;126)	49	137 (78;183)
Skin diseases	443	53 (39;75)	424	53 (39;75)	18	72 (50;116)	1	65 (65;65)
Musculoskeletal diseases	1688	89 (46;183)	1370	79 (40;166)	**228**	**112** (67;232)	**90**	**176** (99;365)
Symptoms, signs, ill-defined conditions	296	54 (30;108)	245	48 (27;88)	36	103 (53;271)	15	176 (78;336)
Injuries	3293	67 (43;111)	2988	64 (41;106)	**234**	**101** (62;193)	**71**	**159** (72;337)
Overall	15238	68 (41;131)	13358	64 (40;119)	1402	108 (60;221)	478	169 (86;347)

(*) SA durations calculated as time to case closure by Kaplan-Meier method; P50: 50th percentile of the SA episode duration (median duration, MD); P25,P75: 25th and 75th percentiles of the SA episode duration.

• There was a **clear increasing trend in MD** as the number of co-diagnoses increased (Figure 1)

FIGURE 1 Case closure probability according to the number of co-diagnoses appearing over the course of the sickness absence episodes between 2004 and 2007.



• The multivariate analysis confirmed the **increasing MD trend in both genders** although it was **greater in men** (Table 2)

• By diagnosis, **duration** was **longer** for **neoplasms, musculoskeletal disorders** and injuries in **men**, whereas in **women** it was **mental disorders** (results not shown)

Table 2. Calculation of the case closure risk, for sickness absence (SA) episodes between 2004 and 2007, by number of co-diagnoses

VARIABLES	MEN						WOMEN					
	HR c	95%CI		HR a	95%CI		HR c	95%CI		HR a	95%CI	
NUMBER OF CO-DIAGNOSES												
No co-diagnoses	1			1			1			1		
1 co-diagnoses	0,62	0,58	0,67	0,62	0,56	0,67	0,69	0,64	0,75	0,65	0,59	0,72
2 or more co-diagnoses	0,46	0,41	0,53	0,46	0,40	0,54	0,51	0,45	0,58	0,49	0,42	0,57

Cox proportional hazards model. A hazard ratio (HR) < 1 reflects a lower case closure probability of the sickness absence episode (i.e., longer duration); HRc: crude hazard ratio; HRa: adjusted hazard ratio by sex, age, education level, autonomous region, type of payment, salary, economic activity, occupation, main initial diagnosis and number of co-diagnoses; 95% CI: 95 % confidence interval for the calculated HR.

d. Conclusions

✓ Co-diagnoses that arise during the course of the SA episodes have an influence on their duration.

✓ Future studies should be more detailed on some pathologies, taking into account what kind of co-diagnoses arise, as well as pre-existing comorbidities and previous SA episodes.

Application

Estimating the SA duration more realistically may allow identification of intervention points to reduce their length.

Improving SA databases could lead to better management of SA episodes by using more specific evidence-based guidelines

The authors state that they have no conflicts of interest.

XXIX Reunión Científica de la Sociedad Española de Epidemiología i XIV Congrés de la Societat Española de Salut Pública i Administración Sanitaria."Salud y equidad en todas las políticas". Organization: SEE. Place: Madrid, Spain. Date: October 2011. Type: oral communication.

M Ubalde-López, J Delclós, E Calvo, F G Benavides. Influencia de los co- diagnósticos en la duración de la incapacidad temporal por contingencia común [Influence of co-diagnoses on duration of non work-related sickness absence episodes]

Ubalde M, Delclòs J, Calvo E, Benavides FG. Influencia de los co-diagnósticos en la duración de la incapacidad temporal por contingencia común. Dins: XXIX Reunión Científica de la Sociedad Española de Epidemiología. XIV Congreso de la Sociedad Española de Salud Pública. Salud laboral. Comunicaciones orales (10 minutos) 490. Gaceta Sanitaria. 2011;25(Supl. E2):265

XXI Diada de la Societat de la Catalana de Seguretat i Medicina del Treball (SCSMT). Organization: SCSMT. Place: Barcelona, Spain. Date: November, 2011. Type: oral communication.

M Ubalde-López, J Delclos, E Calvo, FG Benavides. La duración de los episodios de ITcc varía con los co-diagnósticos aparecidos en su transcurso [Sick leave duration varies with co-diagnoses arising during its course]

Ubalde M, Delclòs J, Calvo E, Benavides FG. La duración de los episodios de ITcc varía con los co-diagnósticos aparecidos en su transcurso. Dins: XXI Diada de la Societat Catalana de Seguretat i Medicina del Treball. Resúmenes de las comunicacions libres. 24 noviembre 2011. Barcelona. Archivos de Prevención de Riesgos Laborales. 2012;15(1):42

XXX Reunión Científica de la Sociedad Española de Epidemiología (SEE): Epidemiología en tiempos de crisis. Haciendo sostenible el Sistema de Salud. Organization: SEE. Place: Santander, Spain. Date: 17-19 October 2012. Type: Oral communications

(312) M Ubalde-López, J Delclòs, E Calvo, FG Benavides. Incapacidad temporal por alteraciones de la espalda y trastornos adaptativos: sexo, edad y ocupación [Sickness absence due to back and adjustment disorders: sex, age and occupation]

(492) Ubalde-López M, Benavides FG, Torá I, Gimeno D, Calvo E, Sampere M, Gil JM, Delclós J. Incapacidad temporal, común y profesional, por lesiones y trastornos musculoesqueléticos. [Health related sick leave of occupational and nonoccupational origin from musculoskeletal injuries and disorders].

M Ubalde-López, J Delclòs, E Calvo, FG Benavides. Incapacidad temporal por alteraciones de la espalda y trastornos adaptativos: sexo, edad y ocupación. Dins: XXX Reunión Científica de la Sociedad Española de Epidemiología (SEE): Epidemiología en tiempos de crisis. Haciendo sostenible el Sistema de Salud. Santander. 17-19 Octubre 2012.
Comunicaciones Orales VI (10 minutos) Salud laboral. 312
Gaceta Sanitaria. 2012;26(Supl. E3):174

Ubalde-López M, Benavides FG, Torá I, Gimeno D, Calvo E, Sampere M, Gil JM, Delclós J. Incapacidad temporal, común y profesional, por lesiones y trastornos musculoesqueléticos. Dins: XXX Reunión Científica de la Sociedad Española de Epidemiología (SEE): Epidemiología en tiempos de crisis. Haciendo sostenible el Sistema de Salud. Santander. 17-19 Octubre 2012.
Comunicaciones Orales VI (10 minutos) Salud laboral.492
Gaceta Sanitaria. 2012;26(Supl. E3):176

Congreso Latino-Americano de Epidemiología y Salud Pública. XXXI reunión científica de la SEE. La ciencia y la práctica de las políticas de salud: la inteligencia de la Salud Pública. Organization: SEE, SESPAS. Place: Granada, Spain. Date: 4-6 September 2013. Type: Oral communication.

(792) M Ubalde-López, D Gimeno, J Delclós, E Calvo, FG Benavides. Multimorbilidad en la población trabajadora que acude a los exámenes médicos de salud: aplicación del análisis de correspondencias [Multimorbidity in a working population attending medical examinations: using the correspondence analysis].

Ubalde-López M, Gimeno D, Delclós J , Calvo E, Benavides FG.
Multimorbilidad en la población trabajadora que acude a los exámenes médicos de salud: aplicación del análisis de correspondencias. Dins: Congreso Latino-Americano de Epidemiología y Salud Pública. XXXI La ciencia y la práctica de las políticas de salud: "La inteligencia de la salud pública". Comunicaciones orales. La violencia como problema de salud pública. 792
Gac Sanit 2013;27 (Supl C2):34

XXXII Reunión Científica de la SEE. IX Congreso da Ape. Primum non nocere. Organization: SEE. Place: Alicante, Spain. Date: 3-5 September 2014. Type: Oral communication.

(106) Ubalde-Lopez M, Delclos G, Gimeno D, Calvo-Bonacho E, G Benavides F. Multimorbilidad y bajas previas como determinantes de la incidencia de incapacidad temporal por patologías [Multimorbidity an previous sickness absence as determinants for incidence and duration of sickness absence by pathologies].

Ubalde-Lopez M, Delclos G, Gimeno D, Calvo-Bonacho E, G Benavides F. Multimorbilidad y bajas previas como determinantes de la incidencia de incapacidad temporal por patologías. Dins: XXXII Reunión científica de la Sociedad Española de Epidemiología y IX Congresso da Associação Portuguesa de Epidemiologia Primum non nocere (primero no dañar). Tercer día de Comunicaciones. 106
Gac Sanit 2014;28(Supl C):298

7th European Public Health Conference: Mind the gap: Reducing inequialities in health and health care. Organization: European Public Health Association (EUPHA) section on Social security and health .Place: Glasgow, Scotland. Date: 19-22 November 2014.

Ubalde-Lopez M, Delclos G, Gimeno D, Calvo-Bonacho E, Benavides FG. Multimorbidity as a determinant of incident sickness absence.Type: Workshop: Chronic diseases and employment in Europe-increasing the gap?. Avaliable at: http://eurpub.oxfordjournals.org/content/eurpub/24/suppl_2/cku151.070.full.pdf Publication: Eur J Public Health 2014; 24 (Suppl 2): cku151-070.

Ubalde-Lopez M, Delclos G, Gimeno D, Calvo-Bonacho E, G Benavides F Multimorbidity as a determinant of incident sickness absence. Type: Pitch communication. Avaliable at: http://eurpub.oxfordjournals.org/content/eurpub/24/suppl_2/cku161.095.full.pdf. Publication: Eur J Public Health 2014; 24 (Suppl 2): cku161-095.

Ubalde-Lopez M, Delclos G, Gimeno D, Calvo-Bonacho E, Benavides FG. Multimorbidity as a determinant of incident sickness absence. Dins: 7th European Public Health Conference: Mind the gap: Reducing inequialities in health and health care. Parallel Session 1: Thursday 20 November 2014, 13:40-15:10. M 1. Workshop Chronic diseases and employment in Europe-increasing the gap? Eur J Public Health 2014; 24 (Suppl 2):32. DOI: http://dx.doi.org/10.1093/eurpub/cku151.070

Ubalde-Lopez M, Delclos G, Gimeno D, Calvo-Bonacho E, G Benavides F Multimorbidity as a determinant of incident sickness absence. Dins: 7th European Public Health Conference: Mind the gap: Reducing inequialities in health and health care. Parallel Session 2: Thursday 20 November 2014, 16:00–17:00, Pitch communication. Eur J Public Health 2014; 24 (Suppl 2): 88 DOI: http://dx.doi.org/10.1093/eurpub/cku161.095

24th International Epidemiology in Occupational Health – EPICOH 2014: Challenges to Occupational Epidemiology in the 21st Century. Organization: The Scientific Committee on Epidemiology in Occupational Health (EPICOH) of the International Commission on Occupational Health (ICOH). Place: Chicago, IL, USA. Date: 24-27 June 2014. Type: Oral communications

(0012) Ubalde-Lopez M, Gimeno D, Delclos GL, Calvo-Bonacho E, Benavides FG. A holistic approach to calculating a multimorbidity score: the usefulness of multi-correspondence analysis. Available at: http://epicoh2014.uic.edu/ oemed-2014-102362.pdf. Publication: Occup Environ Med 2014; 71(Suppl 1):A1.

(0095) Ubalde-Lopez M, Gimeno D, Delclos GL, Calvo-Bonacho E, Benavides FG. Multimorbidity and previous sickness absence episodes are determinants of incidence and duration of future episodes. Available at: http://epicoh2014.uic.edu/ oemed-2014-102362.pdf. Publication: Occup Environ Med 2014; 71(Suppl 1):A10.

Ubalde-Lopez M, Gimeno D, Delclos GL, Calvo-Bonacho E, Benavides FG. A holistic approach to calculating a multimorbidity score: the usefulness of multicorrespondence analysis. Dins: 24th International Epidemiology in Occupational Health – EPICOH 2014: Challenges to Occupational Epidemiology in the 21st Century. 24-27 June 2014. Type: Oral presentation 012. Occup Environ Med 2014; 71(Suppl 1):A1.
doi:10.1136/oemed-2014-102362.1

Ubalde-Lopez M, Gimeno D, Delclos GL, Calvo-Bonacho E, Benavides FG. Multimorbidity and previous sickness absence episodes are determinants of incidence and duration of future episodes. Dins: 24th International Epidemiology in Occupational Health – EPICOH 2014: Challenges to Occupational Epidemiology in the 21st Century. 24-27 June 2014. Type: Oral presentation 095. Occup Environ Med 2014; 71(Suppl 1):A10.
doi:10.1136/oemed-2014-102362.30

Abstract #: **O 33**

BEYOND RETURN TO WORK: THE EFFECT OF MULTIMORBIDITY ON WORK FUNCTIONING AFTER SICK LEAVE DUE TO COMMON MENTAL DISORDERS

Monica Ubalde-Lopez[1], Iris Arends[2], Josue Almansa[2], George L Delclos[3], David Gimeno[4], Ute Bültmann[2]

[1] CISAL-Center for Research in Occupational Health, Universitat Pompeu Fabra, Barcelona, Spain.
[2] Department of Health Sciences, Community and Occupational Medicine, University Medical Center Groningen, University of Groningen, Groningen, the Netherlands
[3] Southwest Center for Occupational and Environmental Health, Division of Epidemiology, Human Genetics, and Environmental Sciences, The University of Texas Health Science Center at Houston, Texas, USA
[4] Southwest Center for Occupational and Environmental Health, Division of Epidemiology, Human Genetics, and Environmental Sciences, The University of Texas School of Public Health, San Antonio Campus, Texas, USA

Corresponding author's e-mail: monica.ubalde@upf.edu

Background: Common mental disorders (CMD) are a major concern in working populations due to their high prevalence and as a barrier to remaining healthy and productive at work. Several other morbidities are linked to mental disorders: in general, up to 70% of CMD patients have at least one co-morbidity. The number and type of chronic health conditions limits the ability to carry out specific work demands and thus the ability to function at work. We aimed to assess the impact of multimorbidity, defined as two or more co-occurring chronic health conditions, on work functioning among workers who had returned to work after sick leave due to CMD.

Methods: Prospective cohort study of 157 workers followed during one year after return to work from sick leave due to CMD. Chronic health conditions were measured at baseline. Simple logistic regression analyses were conducted to examine the impact of each condition on self-rated health. Multiple regression models were adjusted for health-related behaviors (alcohol and tobacco consumption, physical activity). A multimorbidity score (MMBS) was computed by counting severity-weighted conditions. Work functioning was measured at baseline and 3, 6 and 12 months follow-up with the Work Role Functioning Questionnaire (WRFQ). Work functioning trajectories (WFTs) were identified using latent class growth analysis which we use to investigate if MMBS predicted WFTs, and whether WRF was affected by MMBS within each trajectory.

Results: A total of 55% of the workers reported at least one chronic health condition: 33% had multimorbidity. The most prevalent chronic health conditions were musculoskeletal disorders (24%), cardiovascular (13%) and skin diseases (10%). Four WFTs were identified: WFT1 (11% of the workers) showed increasing work functioning scores during follow-up, whereas the other WFTs showed stable low [WRT2], medium [WRT3] and high [WFT4] scores (25%, 41% and 23%, respectively). WFTs with lower work functioning scores tended to show higher

MMBS. However, MMBS did not predict the membership probability to WFTs. Only within WFT1 levels of work functioning were lower while MMBS increased: one unit of MMBS implied a reduction of 1.5 points on work functioning score.

Conclusions: Multimorbidity has a negative impact on workers' perception of work functioning after return to work from sick leave due to common mental disorders. Return to work programs may benefit from incorporating measures to detect and better manage factors related to decreased work functioning in workers with multimorbidity.

<< back to programme

8.4 Appendix IV: Others published papers related to the thesis

Ubalde-López M, Delclos GL, Calvo E, Benavides FG. Influence of new secondary diagnoses on the duration of non-work-related sickness absence episodes. J Occup Environ Med. 2013 Apr;55(4):460-4. doi: 10.1097/JOM.0b013e3182821b43

Gimeno D, Bültmann U, Benavides FG, Alexanderson K, Abma FI, Ubalde-López M, Roelen CA, Kjeldgård L, Delclos GL. Cross-national comparisons of sickness absence systems and statistics: towards common indicators. Eur J Public Health. 2014 Aug;24(4):663-6. doi: 10.1093/eurpub/cku070

Ubalde-López M. Respuesta: Reincorporación al trabajo tras un episodio de incapacidad temporal por trastornos musculoesqueléticos: revisión sistemática de guías de buenas prácticas. Arch Prev Riesgos Labor. 2015 Jul-Sep;18(3):148-9. doi: 10.12961/aprl.2015.18.3.06.

8.5 Appendix V: Scientific Seminar Guest

EOHS *Research Seminar Series*

Influence of Co-Diagnoses on the Duration of Non-Occupational Sickness Absence

Monica Ubalde, MS

Universitat Pompeu Fabra
Barcelona, Spain

Friday, April 19, 2013

RAS-W304 & ITV
Noon – 1PM

Lunch will be provided

For additional information: Please contact Cheryl Hayes (713) 500-9462 Cheryl.Hayes@uth.tmc.edu

*Please contact your ITV technician or administrator if you would like to receive the seminar via an ITV transmission.

UTHealth | School of Public Health
The University of Texas
Health Science Center at Houston

Scientific seminar
University Medical Center Groningen (UMCG)
Department of Health Science, Community and Occupational Medicine
14th November 2014

"Multimorbidity in working populations. Looking at sickness absence and beyond"

Mònica Ubalde López, MOH
Center for Research in Occupational Health (CiSAL)
Universitat Pompeu Fabra
Barcelona, Spain

Het seminar vindt plaats op vrijdag 14 November 2014 van 10-11.30 uur in lokaal 6 van het Onderwijscentrum. Iedereen is van harte welkom.