Inequalities in blindness, visual impairment and related eye diseases in Spain

An approach from socioeconomic position, gender and territory.

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Summary

The aim of this thesis is to explore geographic, socioeconomic position, and gender inequalities in the prevalence of visual impairment and blindness. The thesis includes 3 papers that address each of these dimensions of inequality. Data were obtained from the 2008 Spanish Survey on "Disability, Personal Autonomy and Dependency Situations". The results of these studies suggest that there are regional, gender and socioeconomic inequalities in the prevalence of visual impairment in Spain. This study improves our understanding of these inequalities, and shows for the first time that the higher prevalence of visual impairment among low-income regions, women, or individuals with low socioeconomic status is associated with specific eye diseases that are related to unmet need for eye care beyond the patient's control. Policies to improve the quality of services, reduce inequalities in the therapeutic and diagnostic effort and the role of traditional masculinity are recommended.

Resum

L'objectiu de la tesi és explorar les desigualtats geogràfiques, de gènere i de posició socioeconòmica en la prevalença de la discapacitat visual i ceguesa. La tesi consta de 3 articles que analitzen cadascuna de les dimensions de desigualtat considerades. Les dades s'obtenen de l'Enquesta Espanyola de 2008 sobre "Discapacitat, Autonomia personal i situacions de dependència" i mostren que existeixen desigualtats regionals, de gènere i socioeconòmics en la prevalença de discapacitat visual a Espanya. Aquest estudi millora comprensió d'aquestes desigualtats i mostra que la major prevalença de discapacitat visual en les regions de baixos ingressos, les dones o les persones amb baix nivell socioeconòmic està associada amb determinades patologies oculars relacionades amb necessitats no cobertes fora del control del pacient. Es recomana la implementació de polítiques per millorarla qualitat dels serveis, reduir les desigualtats en l'esforç terapèutic i de diagnòstic i en el paper la masculinitat tradicional hegemònica.

Preface

This thesis combines knowledge about eye care in under-served population groups that we have acquired through our work at the UNESCO Chair on Visual Health and Development, and in several non-profit associations focused on blindness, as well through my work as an activist against inequalities and my political commitment to social movements. The experience of working in the refugee camps in Bosnia in 1995, where we dealt with the survivors of the Srebrenica massacre, completely changed our lives and our commitment to the fight against injustice. The following year Laura Guisasola and 20 optometry students and professors started working on solidarity projects that are still running today. In all these years we have found that blindness is not just a biological disease, but an important facet of poverty in many parts of the world, including Catalunya. Visual impairment is most often due just to a lack of transportation or inability to pay for a pair of glasses or outpatient surgery. It is also most often simply a consequence of shortcomings in the national health system. Twenty years on, and after years of work on international projects, we joined the International Agency for the Prevention of Blindness initiative (IAPB). As a university network, we become part of the research team while simultaneously improving our research skills through the Masters in

Public Health at Universitat Pompeu Fabra (UPF). During this time we realized that the global effort to measure visual health and blindness, supported by the IAPB and the World Health Organization, was not taking any kind of inequality into account. This effort simply measured the prevalence of blindness in various countries without considering the influence of socioeconomic position, sex or region during sample selection or in the analysis. Given our experience working in impoverished populations and the clearly important role of poverty in risk of blindness, we found it hard to understand that something so important as socioeconomic position was not being considered in the most commonly-used protocols and policy decisions. This problem became even more apparent when we became involved in organizing World Sight Day (2009), which was dedicated to gender inequalities. The international visual health community was well aware of the fact that women account for about two thirds of blindness worldwide, but the lack of published research on gender inequalities prevented us even from describing the mechanisms involved, and we were only been able to publish a compilation of case reports from around the world. In our local setting, data on visual impairment or blindness were available from national health surveys but had never been

analyzed; this gave us a compelling opportunity to improve the state of research in this area.

It was also necessary to fill the knowledge gap and give the international community a strong reminder to never again omit the issue of inequality from protocols and policies on visual health. This thesis also seeks to overcome the preconception that the study of inequalities is the remit of non-profit organizations working for the poor, but rather is everyone's business. These studies can produce quality research outcomes, orient government planning, and improve professional performance. For these reasons, I present this thesis not only with personal satisfaction, but also as the resolution of a personal commitment to health and equality.

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1 Introduction

1.1 Social determinants of health inequalities: concepts, causes and effects

Social inequalities in health are those unfair, systematic and socially produced differences (1) in the health of a population when stratified according to their position in the hierarchy of power. In consequence, most of those inequalities are unnecessary, avoidable and intolerable (2).

The accumulation of resources and power in the richest countries, restricted economic elites (3), and the perpetuation of the power and resources among men versus women produces an unequal distribution of damaging experiences that lead to worse health among the poor and among women, and a social gradient in health within and between countries (4). The conceptual framework developed by the Spanish Commission to Reduce Social Inequalities in Health highlights various spheres of social determinants that contribute to health inequalities. These can be structural determinants such as socioeconomic, cultural and political context, and can determine different groups' exposure to intermediate factors or determinants such as material resources, social and cultural capital (5), behavioral, occupational, and psychosocial factors, and health services. Health care systems are one of the main intermediate health determinants that interact with structural determinants, such as level of development of

social policies, which determine differences in access to, and quality and effectiveness of health systems between men and women, and between social classes and regions. These inequalities result in differences in people's health (4).

The world's current level of wealth would permit an equitable distribution of resources without compromising quality of life (6), and an equitable distribution of this wealth may produce even better results than medical advances (7). In this sense, the inequality we observe in almost all countries in the world cannot be justified by the argument that there is insufficient wealth. However, in the context of the current economic crisis, inequalities are increasing significantly.

1.2 Health inequalities and inequality dimensions

Health inequalities are an important focus in the study of inequality and the defense of human rights because, as it was said by Frank Dobson, who was the British Secretary of State for Health, "There is no more serious inequality than knowing that you'll die sooner because you're badly off" (8,9). The Commission on Reducing Social Inequalities in Health in Spain identifies the following dimensions of inequality: age, ethnicity, social status, gender and territory; this thesis focuses on the last three of these

dimensions (see section 1.2.1 to 1.2.3). Those dimensions are linked to discrimination related to power, prestige, and access to resources (10). Social determinants affects people's health differently regarding these inequality dimensions. The study of health inequalities allows us firstly to measure violation of the human right to health and freedom from discrimination, and secondly to determine strategies for reducing excess mortality, disability and morbidity in vulnerable groups. It is essential to understand the mechanisms and social determinants involved, since inequalities are socially produced and therefore not fixed or unavoidable but amenable to alteration (1).

1.2.1 Geographic inequalities

Geographic inequalities in health can be observed both between high-income countries and between regions within those countries. For example, life expectancy at birth in the world's richest countries, which have more effective and efficient welfare states, was 38 years higher in 2012 than in the most impoverished ones (11), and infant mortality rates varied from 2 to 114 per 1000 live births (12). Even in Europe, we observe significant differences in health between countries with more distributive policies (13). The reasons why people in one area are markedly less healthy than those in another area may be driven by a combination of individual

and contextual factors. There are important differences in policy implications for situations where geographical inequalities are related to a higher proportion of individuals who are at greater risk of illness, or where some contextual feature increases disease risk. Current evidence suggests that both compositional and contextual factors play key roles in determining inequalities in health outcomes between areas, population groups, or individuals (14). The differential distribution of age and socioeconomic position between areas could partially account for these inequalities, since these factors are associated with risk of health outcomes. However, territorial contextual factors, such as regional income, level of development, regional policies or quality of services could also be important.

In Spain, excess mortality in more deprived areas accounts for ~35,000 deaths per year (15). People living in the south of Spain report poorer self-perceived health status than those living in other regions (16). These differences may be associated with exposure to individual risk factors, such as diabetes, glycemic diet (17,18), smoking, and hypertension (19), as well as to contextual regional variations, such as cultural differences in diet. The Spanish health care system provides universal coverage, with similar benefits across regions, in theory. However, budgets and regional

public health policies are the responsibility of regional governments, and may influence the regional differences observed.

1.2.2 Gender inequalities

Gender inequalities are, along with socioeconomic inequalities, the most important determinants of inequality in health and access to healthcare (20). Health differences between men and women are intrinsically linked to a combination of factors that make us different from biology and unequal due to social factors (21). As a result, women generally have poorer health and greater disability than men, and men have a lower life expectancy (4). The traditional social model of hegemonic masculinity conditions men to exercise self-control, be active and strong, endure pain, and not seek help (22,23). This social model is also associated with risk behaviors that are linked to men's lower life expectancy, including: difficulty in admitting that they have symptoms of body alarm, postponing to react when they feel discomfort as it is experienced as an uncontrollable threat of his body, delayed attendance at health services because it is perceived as a failure of self-sufficiency, and poor adherence to treatment (24–26).

Although women account for 59.8% of disabled people in Spain, and generally have a higher prevalence of disease (27), men live almost five years less than women, on average (28). Exposure to major risk factors for health, such as obesity, alcohol consumption and smoking, is higher among men (29) and could be associated with the observed gender inequalities. Considering gender as a social construct that influences behavior, roles and interactions between men and women (30), cultural factors, such as discrimination against women or sexism and attributed social roles (20), have important implications for population health. Less intense diagnostic and therapeutic effort among women is observed for organ transplants (31,32) and emergency treatments (33) in high-income countries, as well as for hospital utilization, treatment and pharmaceutical spending in Spain (34). For example, although women have poorer health and greater disability than men (4), they are generally prescribed cheaper treatments and less medication (34). In contrast, men are less likely to attend health care services, and have higher rates of premature death linked to the inhibition of weakness or emotional expressiveness that influence the perception of symptoms and the development of dangerous behaviors (35). While there are differences in the prevalence of illness and risk factors between men and women, the gender perspective is not broadly

incorporated into health research, and consequently is not frequently considered in health planning (20).

1.2.3 Socioeconomic inequalities

There is extensive and consistent evidence on the existence and impact of social inequalities on health. Individuals with lower socioeconomic position in the society have poorer health status, greater disability, and shorter life expectancy than more advantaged socioeconomic groups (4) in both sexes, although via different mechanisms (36). Socioeconomic inequalities account for more excess mortality and morbidity than any other known risk factor (7,37,38). These differences not only occur between the extremes of the social spectrum, but also across a social gradient, with health outcomes gradually worsening with decreasing relative socioeconomic status regarding their position in the whole society (39). For example, a higher incidence of cancer is observed among individuals with low socioeconomic status in Spain but only associated with increasing risk of mortality among men. The incidence of perinatal mortality and cardiovascular disease is also higher among low socioeconomic status population (20).

Socioeconomic inequalities could be the result of differences in disease incidence or they can operate through different mechanisms in different

socioeconomic strata, including differences in help-seeking behavior related to attitudinal and cultural factors between individuals and societies, barriers to health care access related to policies and structural factors (4), and lower diagnosis and treatment effort related to professionals' attitudes. This can result in delayed diagnosis and treatment in disadvantaged socioeconomic groups (40). Individuals with low socioeconomic status experience barriers to health care, including economic barriers, resulting in lower attendance to health care (40). Lower educational level is also related to difficulties in identifying symptoms and less awareness of disease, which could also result in lower attendance (41). Low socioeconomic status is also associated with greater exposure risk factors for mortality, such as smoking and hypertension, considered intermediate determinants. A more developed welfare state could reduce the socioeconomic inequalities by providing more egalitarian access to health services and reducing exposure to risk factors. For example, while differences in mortality rates between socioeconomic groups are 691 excess of deaths per 100.000 women and 1679 for men in Estonia, in Sweden decreased to 258 and 418 respectively (42).

1.3 Visual impairment and blindness

Blindness and low vision are widely recognized as a global public health problem and as important causes of impairment (43,44). The global cost of visual impairment is estimated to be about $3 trillion, and this burden is expected to increase by approximately 20% in the next 10 years (45). In 2010, it is estimated that there were 32.4 million blind people worldwide and 191 million with moderate or severe visual impairment (46). The estimated global prevalence of visual impairment, poor vision and blindness is 4.2%, 3.6% and 0.6%, respectively (47), making it the sixth leading cause of disability worldwide (48). However, it is estimated that up to 80% of blindness and 85% of visual impairment is avoidable (49), and treatment is considered to be one of the most cost-effective interventions (50,51).

1.3.1 Clinical characteristics of blindness, visual impairment and related eye diseases

Blindness is defined clinically as a visual acuity (VA) in the best eye, and with correction, of <3/60 and visual impairment as <6/18 and ≥3/60, or the equivalent in visual field loss. Visual impairment is also subcategorized as moderate (VA <6/18-6/60) or severe (VA <6/60-3/60), according to the International Classification of Diseases 10th Revision (ICD-10) (52).

A 2010 study in high-income countries in Western Europe found that blindness or visual impairment was associated with eye diseases or conditions such as macular degeneration (16.1%), uncorrected refractive error (14.0%), cataract (13.8%), glaucoma (10.6%), and diabetic retinopathy (4.2%), with unidentified or other causes also important (41.4%) among the visually impaired. This distribution was similar to that observed in other high-income regions, and also to results for Europe from 20 years ago, the only difference being a decrease in the prevalence of cataract (19.2%), and an increase in the prevalence of unidentified or other causes (37.4%) (53).

1.3.2 Risk factors, diagnose and treatment of eye diseases

The type and complexity of prevention, diagnosis and treatment of eye diseases related to visual impairment are important factors for understanding the mechanism involved in inequalities in prevalence. Only cataract and uncorrected refractive errors are considered avoidable or treatable causes of visual impairment (54). The distributions of risk factors associated with eye diseases and conditions, such as diabetes, hypertension, exposure to UV light, smoking and diet, differ between sexes, socioeconomic status individuals and regions, and may contribute to the differences in incidence of visual impairment between these groups.

Age-related Macular Degeneration (AMD), characterized by damage to the macula and loss of central vision, is the leading causes of visual impairment in Europe. Early detection of this disease is difficult, as it is asymptomatic in the early and intermediate stages, and can only be detected by a comprehensive dilated eye exam. There is currently no treatment for AMD, although vitamin supplements can delay the progression of the disease and injections the progression of neovascularization. The main risk factors associated with AMD are age, smoking (55), cholesterol, body mass index (56) and diabetes (57).

Refractive error is caused by inadequate power of ocular diopters or axial length of the eye, resulting in blurring at the retina and decreased visual acuity. It can be detected using a visual acuity test, diagnosed using a refraction test, and easily corrected using glasses or contact lenses (58).

Cataract is a clouding of the eye lens that can be easily detected using a visual acuity test and a slit lamp. It can be effectively treated with surgery to remove the cloudy lens and replace it with an artificial lens. The main risk factors associated with cataract are age, exposure to ultraviolet light (59,60) and diabetes (61,62).

Glaucoma is an optic nerve damage commonly associated with excess of eye pressure. It causes loss of peripheral vision in advanced stages, and

over time, central vision may diminish until no vision remains. Some types of glaucoma are asymptomatic, and regular eye care visits are key for early detection, and prevention of vision loss. This disease is incurable, but can be treated early with pressure-lowering eye drops or laser trabeculoplasty to drain the fluid from the eye. Risk factors associated with glaucoma are elevated internal eye pressure, age and some ethnicities.

Diabetic retinopathy causes damage to the blood vessels in the retina among people with diabetes, and can lead to bilateral loss of vision in the latter stages of the disease. The disease is typically asymptomatic in its early stages and usually painless. A routine of comprehensive dilated eye exams at least once a year among diabetic patients is important for an early detection. Diabetic retinopathy is incurable, although progression can be prevented by closely monitoring blood levels of sugar and cholesterol, and of blood pressure. Advanced stages can be treated with retinal laser surgery to shrink the abnormal blood vessels, and vitrectomy to remove blood. Risk factors associated with diabetic retinopathy include diet, blood pressure and smoking (57,61).

Other and less frequent causes of visual impairment in Spain include magna myopia and retinitis pigmentosa (63).

Some of the studies report unidentified eye that can be whether related to other uncommon eye diseases or to non-diagnosed eye diseases.

1.3.3 The eye-care system in Spain

The Spanish Health Care System predominantly operates in the public sector and provides universal coverage (excluding non-regularized immigrants). It is funded by taxes and provision is free of charge, excepting for pharmaceuticals. While Spain has relatively low health expenditure (8.5% of GDP) compared to other high-income countries (15.6% of GDP in United States), health outcomes such as life expectancy are higher (83 years in Spain compared to 79 in the US (11)). Health competencies are the responsibility of the 17th regional autonomous governments, although the national Ministry of Health and Social Policy (MSPS) holds authority over certain strategic areas. The National Health System was founded by Franco's dictatorial government and was primarily, and still remains, more focused on treatment than prevention, from more of a welfare or charity for the underserved population than a welfare state perspective (13).

The Spanish National Health System offers free and universal eye care services for the diagnosis and treatment of eye disease, except for compensation for refractive errors. However, quality barriers among the ophthalmic services are observed as of all surgeries and outpatient clinics

in Spain, cataract surgery and outpatient ophthalmology visits have the longest waiting lists and the highest number of waiting days (64), and patients are generally more willing to pay for eye care services than in other countries with a universal free eye care (65).

The eye care professionals in Spain include ophthalmologists and optometrists, who can detect eye diseases and diagnose and treat refractive errors. The numbers of attending eye care professionals (66) and private eye care centers per head of population are similar to those in other high-income countries, although there are regional differences within regions of Spain (67). Lower rates of practicing ophthalmologists in France (68) and of vision services providers in the United Kingdom (69) have been found to be associated with higher prevalence of visual impairment; this could give rise to regional inequalities in Spain, if present.

Less intense therapeutic effort is observed among women in Spain, in terms of hospital utilization, treatment and pharmaceutical spending (34). The outcomes of cataract surgery conducted within the Spanish National Health Service are less favorable among low educational level groups (70), suggesting lower therapeutic effort in socioeconomically disadvantaged groups.

1.4 Inequalities in blindness and visual impairment

While there is consistent and abundant evidence regarding the effect of social determinants on people's health (4), little is known about how social determinants affect disability and low-mortality diseases, such as visual impairment. For example, only 23 of the 565 studies on inequality published between 2000 and 2011 stratify their results on the prevalence of blindness and visual impairment according to structural social determinants of health, such as gender, income, educational level, employment status, social class, and ethnicity/race. Since 2011, there has been growing interest in the relationship between inequality and blindness, although there have been no remarkable new contributions to the field since then. While there has generally been little research into inequalities in blindness and visual impairment, there is some evidence of the indirect influence of social determinants on the prevalence of blindness and visual impairment. This evidence is summarized in the literature review conducted during this thesis (see Annex 1) (71).

While this thesis is focused on inequalities related to region, socioeconomic status and gender, the role of age in these three dimension is also a substantial part of our results. There is a widely reported association between visual impairment and age, with recent data indicating that 63% of visually impaired and 82% of blind people are aged ≥50 years

(47). This may be due to biological mechanisms, as eye diseases are age-related. However, other cohort factors related to higher rates of illiteracy in older age groups related to more precarious working conditions and lower income to pay private substitutive eye care could also be involved. Discrimination among the older could also explain the higher prevalence as a lower diagnosis effort among them is observed (72,73).

The prevalence of visual impairment, blindness and related eye diseases is associated with ethnicity, which is also an important dimension of inequality for blindness and visual impairment (74–77). The mechanisms underlying ethnicity-related inequalities are not well understood, and they may be related to biological factors that produce differences in the incidence of eye diseases as well as to differences in socioeconomic status between ethnic groups (71). Discrimination against certain ethnic groups could also be involved, and would create inequalities in diagnosis, treatment, and access to health services. Since mass immigration is a relatively recent phenomenon in Spain, and immigrant population is still young, the ethnic dimension of inequality is not considered a priority for this thesis, which focuses on the previously described geographic, gender and socioeconomic dimensions of inequality, whose mechanisms remain unclear.

1.4.1 Geographic inequalities

Geographic inequalities can be observed on a worldwide, national and regional scale, with 87% of visually impaired (49) and 90% of blind people (78) living in developing countries. In 2010 some sub-regions of Africa (WHO classification) and Asia had an age-adjusted prevalence of blindness greater than 4% among older adults, whereas in high-income regions, such as Western Europe, North America and Asia Pacific, the prevalence was lower than 0.4% (46).

Geographic inequalities in the prevalence of blindness and visual impairment not only affect low-income regions, but are also observed among Western European countries (79), ranging from 0.2% to 0.4% for blindness and 1.4% to 1.9% for visual impairment, and affecting 937,000 and 6,372,000 Europeans, respectively (78). These inequalities can extend beyond national borders and are also observed between regions within both low and high-income countries, although data are scarce and geographically limited for high-income countries (80–84).

Geographic inequalities between regions within high-income countries may be partly due to differential distribution of age (47) or socioeconomic position between regions, as these dimensions are associated with risk of visual impairment and blindness (71). Examining these factors separately, regional differences in age structure do not seem to fully explain these

inequalities as those persisted after adjusting for age (46). Differences in socioeconomic position also do not seem to fully explain these inequalities, as an independent ecological effect on regional risk of poor vision was observed in France after adjustment for age and occupation (68). A number of potential contextual factors may be important, such as differential levels of regional economic development, welfare state policies, rural environment and quality, and the availability of eye care services. There is evidence of an ecologic effect of national income, since Gross Domestic Product (GDP) *per capita* is associated with the prevalence of blindness (85). This effect may be associated not only with the addition of the individuals socioeconomic position but also with regional structural determinants linked to regional economic development. For example, studies in the UK (86) and Singapore (87) found that the level of deprivation of neighborhoods was independently associated with low vision after adjusting for individual socioeconomic position. There is little evidence regarding the role that welfare state policy plays in the prevalence of visual impairment, although this evidence does exists for other health conditions. Budget for welfare state policies in the 5 states of Canada were correlated with the prevalence of registered blindness (88), although registration could be related to the availability of subsidies. Lower quality

and availability of eye care services in the impoverished areas (89) could partly explain the association with regional economic development, as it was described before the prevalence of low vision was found to be inversely correlated with the number professionals attending (68), and number of eye care services (69).

The observed inequalities could also be explained by the known regional variations in risk factors associated with visual impairment, such as diabetes, exposure to ultraviolet light, hypertension, diet, obesity, and smoking.

1.4.2 Gender inequalities

Visual impairment is generally more prevalent among women, regardless of age (90,91), with the female/male prevalence ratio estimated to be 1.1 to 1.5 in 2010 (46). The prevalence of blindness and visual impairment is also higher among women in high-income countries, regardless of age (92–95), although the mechanisms that produce these gender inequalities are not well understood. Gender inequalities could be due to gender differences in incidence, which could be related to differential exposure to risk factors for eye disease, such as diabetes, hypertension, and smoking, although there is no evidence of gender differences in the incidence of visual impairment (96,97) or ocular disease (61,98) except for AMD.

Gender inequalities in the prevalence of visual impairment could be due to the earlier onset of visual impairment in women and the resulting cumulative effect, although the scarce literature does not support this notion. For example, boys born before 25 weeks gestation are more susceptible to visual impairment than girls (99), and blindness and visual impairment is higher among Swedish boys (100).

Gender inequalities can operate through different mechanisms in women and men, including access barriers to health care services (101) and lower treatment effort (32,34,102,103) among women, and aversion to help-seeking resulting in delayed diagnosis and treatment among men. Women are generally more likely to use health care services (103) and have a more effective use of eye care services than men.

A growing body of evidence from gender-specific studies highlights the tendency among men to delay seeking help when they become ill. Social norms regarding traditional masculinity constrain help-seeking among men, mainly due to their attributed role of self-sufficiency and restrained emotional expressivity, influencing their perception of symptoms and weakness (24–26). For example, an Australian study found that women were more likely to use optometrist services, a fact that was not explained by incidence or barriers to access, but probably by differences in their

attitude to when and how to seek health services (104). The main reason given by US men with a visual impairment for not visiting an eye care professional was that it was not necessary (105).

Delayed diagnosis and poorer prognoses for some types of visual impairment in men may be due to their reluctance to use health care services.

1.4.3 Socioeconomic position inequalities

Low socioeconomic status is associated with a higher prevalence of blindness and visual impairment (74,106–108), although the mechanisms that produce these socioeconomic inequalities are not well understood.

Socioeconomic inequalities could be the result of differences in the incidence of eye diseases that causes the impairment, or the mechanisms through which they operate through different according to individual or group socioeconomic status, including via different patterns of help-seeking behavior related to attitudes and cultural factors, access barriers to health care services related to policies and structural factors (101), and less intense diagnosis and treatment effort related to professionals' attitudes, resulting in delayed diagnosis and treatment among individuals with a lower level of educational.

Although information is scarce for high-income countries, a higher incidence of visual impairment is found among individuals with lower socioeconomic position (96) that could be related to greater exposition of eye diseases determinants as smoking (55), obesity, diabetes (109), physical activity (110).

In addition to incidence, other reasons for a higher prevalence may include lack of knowledge of eye disease among low educational level, as was found to be the case for glaucoma and AMD in Canada (111). This lack of awareness hinders patients ability to identify symptoms and seek help, and could also partly explain the lower frequency and later attendance at services observed among individuals with a lower educational level who are at risk of developing eye disease (103) or who have undiagnosed eye disease (112).

A US study found that, after diagnosis, socioeconomic inequalities in attendance at healthcare services persist, with individuals with lower income or lower educational level being significantly less likely to visit their eye care provider (113). These observations suggest that not only are there barriers related to help-seeking behavior, but, since these patients had already been diagnosed, there are also barriers to affordable, accessible, and quality services. For example, economic barriers as declared as the

main reason for not attending an eye care professional among low educational level individuals with a visual impairment in US (105). Contextual barriers are also relevant. For example, lack of information about a campaign was highlighted as a contributing factor to increased socioeconomic inequality in attendance at eye care clinics after implementing a free examination policy in Scotland (114); in this case, the information was mainly received by more advantaged groups. Finally, lower diagnosis and treatment effort could partly explain the fact that the socioeconomic gradient we observe among visually impaired individuals who attend eye care services is similar to that among those who do not attend these services; these inequalities would be expected to disappear as a results of attending these services (115).

Gender inequalities might also play a role in inequalities related to educational level, since women are observed to have a higher incidence of visual impairment, cataract and AMD, in addition to other factors such as the different sex patterns in help seeking behavior (24–26), higher attendance at eye care services (104), and lower diagnosis and treatment effort (32,34,102).

1.5 Blindness and visual impairment in Spain

According to the National Statistics Institute, there are 979,200 visually impaired individuals in Spain (371,400 men and 607,800 women) and 59,541 are blind, representing 2.14% and 0.13% of the Spanish population, respectively (63). The prevalence of self-reported visual impairment in Spain is higher than in Italy (2.1%) (79), France (2.08%) (68), Turkey (1.9%) (116), and the WHO range reported in Western Europe (1.1-1.3%), but lower than in Tunisia (3%) (117) and the Lebanon (3.9%) (118). The Spanish National Organization of the Blind (ONCE), which publishes an annual regionalized summary of the number of registered blind and visually impaired affiliates, reported 63,461 registered visually impaired affiliates (>18 years old) in 2007, 21% of whom were blind (119). However, it is not possible to make inferences about the general population, as there are known biases in registration between men and women, pathologies, treatment availability (120), and socioeconomic position.

Apart from official statistics, there is little information on visual impairment and blindness in Spain, and it is not geographically representative. The only region for which data are available is Catalonia, where the prevalence of blindness and visual impairment is 0.1% (men, 0.1%; women, 0.2%) and 4,7% (4.1%; 5.3% in women), respectively

(108); there are also data for the cities of Cuenca (121) or Albacete (122). According to estimates of visual impairment from the Report on Blindness in Spain extrapolated from data collected by the INE (not stratified by sex or type of disability), there are geographical inequalities that could be due to differences in the proportion of older individuals, the prevalence of diabetes, or differences in disease registration (63).

The prevalence of visual impairment and blindness is higher among women (108,121,122), which may be related to the higher prevalence of diagnosed cataract and glaucoma observed in Catalunya (108). Low socioeconomic status is also associated with visual impairment and blindness (108,122), and could be related to co-morbidities, such as arthritis, stroke, depression and diabetes (123).

1.6 Justification

Socioeconomic, gender and geographic inequalities in visual impairment have been reported, although there is limited evidence for high-income countries, and the underlying mechanisms are not well understood.

It is important to examine whether there are regional differences within the country, and whether these may be explained by factors other than age and individual socioeconomic position, as well as to examine gender and socioeconomic differences, and to evaluate whether age of onset, or

diagnosed or undiagnosed eye disease might also account for these differences. This information is required for a better understanding of the mechanisms that underlie inequalities in blindness and visual impairment in high-income countries, and for instance where policies could make a difference to improve health care access, as well as to understand the steps that should be taken to sensitize health professionals in order to prevent inequalities.

2 Hypotheses and Objectives

2.1 Hypotheses

Our hypotheses are: first, the prevalence of blindness and visual impairment is higher in the poorest regions of Spain, even after adjusting for socioeconomic position and age; second, the prevalence of blindness, visual impairment and related eye diseases is higher among women and this is associated with a higher prevalence of diagnosed eye diseases; and third, the prevalence of blindness, visual impairment and related eye diseases is higher among individuals with lower socioeconomic position.

2.2 Objectives

General objective

To explore geographic, socioeconomic position and gender inequalities in the prevalence of visual impairment and blindness.

Specific objectives

This study had three specific objectives:

First, to examine whether there are regional differences in the prevalence of visual impairment and blindness in Spain, and to explore sex patterns and their relationship with age and individual socioeconomic position.

Second, to analyze gender inequalities in the prevalence of blindness and visual impairment and to explore the role of age of onset of visual impairment, and of diagnosed and undiagnosed eye disease.

Third, to analyze socioeconomic inequalities and explore patterns among sexes in the prevalence of visual impairment and diagnosed and undiagnosed eye disease among the visually impaired.

3 Methodology

3.1 Data

Data were obtained from the 2008 Spanish Survey on "Disability, Personal Autonomy and Dependency Situations", a cross-sectional survey of a representative sample of the non-institutionalized population of Spain. The questionnaire included self-reported information on visual impairment and socio-demographic data. The sample was selected using a multiple stage random sample strategy. The first-stage units were census tracts and the second stage units were family households. One adult aged ≥15 years was selected from each household to complete the questionnaire. A total of 213,626 people were interviewed (103,093 men and 110,533 women). This exceptionally large data allows us to overcome some of the limitations of previous research by stratifying the analysis by sex, considering near and distance visual impairment separately, and controlling for potential differences in age and individual socioeconomic position. Data were collected through face-to-face interviews at home between November 2007 and February 2008 (response rate, 96%). Valid data could not be obtained for 34% of the initially selected units, for the following reasons: not surveyable, 11.7% (dwelling empty, 9.48%; not localizable, other); absent, 11.65%; refused to respond, 9.79%; unable to respond, 0.36%; previously selected, 0.25%; inaccessible, 0.10% (124). Once a household

was selected, in cases where the initial attempt to contact the interviewee failed, several additional attempts were made before replacing households where all attempts failed. The survey methods are described elsewhere (124). For the purpose of this study, the sample was restricted to people aged ≥15 years.

The cross-sectional design of the survey precluded the analysis of internal migration patterns or population changes over the time. However, internal migration between the regions of Spain is uncommon (2.8% of the Spanish population in 2007).

3.2 Health outcomes

3.2.1 Vision outcomes

The diagnosis of visual impairment was based on three questions focused on blindness, near visual impairment and distance visual impairment. To ascertain the severity of visual impairment, the following question was asked: "Are you blind or only able to differentiate between light and darkness?" Information on near and distance visual impairment was elicited using the questions, "Do you have significant difficulty reading newspaper print, even when wearing spectacles or contact lenses?" and on distance visual impairment using the question "Do you have significant difficulty recognizing someone across the street (4 meters distance), even

when wearing glasses or contact lenses?". Individuals with near, distance visual impairment or blindness in any analysis were classified as having "some visual impairment". In theory, visual impairment due to refractive error was expected to be excluded by the phrasing of the question. No information about the use of refractive compensation was collected in the survey. The classification for blindness and visual impairment used in the survey follows the International Classification of Impairments, Disabilities and Handicaps (124). Self-reported visual impairment has previously been found to be significantly correlated with decreased visual acuity (125,126), with high sensitivity and low specificity (127), and that this correlation is stronger among individuals with low visual acuity (<0.2). In addition, sensitivity is higher among women (126).

3.2.2 Diagnosed and undiagnosed eye diseases

Blind or visually impaired respondents were asked the following multiple-choice question: "Have you been diagnosed with any of the following illnesses?" (responses included cataract, diabetic retinopathy, glaucoma, macular and degeneration). Those who responded affirmatively were classified as having been diagnosed with the corresponding eye disease. Individuals who responded that they had never been diagnosed with any of these diseases (representing 90% of blindness in Europe) (43) nor with

myopia magna or retinitis pigmentosa were classified as having undiagnosed eye disease. Visual impairment due to refractive error was not evaluated in this survey, although it is the most important cause of visual impairment worldwide (58). While subjects were asked to consider their level of vision "even when wearing spectacles or contact lenses", responses could be influenced by refractive problems. Such biases could not be detected, measured or corrected for because clinical examinations were not conducted.

3.3 Measures of social inequalities

Region

We selected region of residence as a geographical indicator. Spain has 17 Autonomous Communities with regional governments that are responsible for administering education, health, social and other services. The two very similar small Autonomous Cities of Ceuta and Melilla, located in North of Africa, were considered together as a single region.

Educational level

We used educational level as a measure of socioeconomic position because, while it has a strong "cohort effect", with an accumulation of illiteracy among older individuals, the question on educational level had a high response rate in the sample. As an individual measure of

socioeconomic position, educational level was represented as an eight-category variable, according to the level attained within the Spanish education system: illiterate (unable to read or write), incomplete primary education, complete primary school or equivalent, first stage high school education, second stage high school education, intermediate vocational studies, higher vocational studies, and university degree or equivalent. For analysis of educational level (i.e. as the primary predictor variable), we constructed a four-category variable by combining the last five categories as "secondary or higher education". For other analyses adjusted for educational level, we used the complete eight-category variable.

Age

Age groups were constructed as follows: <25 (16 to 24) years, 25 to 64 years, 65 to 79 years, and ≥80 years.

Age of onset

To detect congenital and perinatal conditions, data were collected on the age of onset of visual impairment, and were categorized as follows: ≤2 years, 3 to 24 years, 25 to 64 years, 65 to 79 years, and ≥80 years.

3.4 Statistical analysis

The prevalences of blindness and visual impairment were calculated for each age group, age of onset, educational level, and region; all of these

results were stratified by sex. The age-standardized prevalence of any visual impairment was calculated and mapped for all regions. The prevalence of specific eye diseases were calculated among population with at least one diagnosis. We used the χ^2 test to compare the distribution in the reference population and the sample or comparing the reference population or the visually impaired or eye diseases samples. To test for regional, socioeconomic position and gender differences in the prevalence of blindness and near and distance visual impairment, we fit multiple logistic regression models to calculate odds ratios (ORs) and 95% confidence intervals (CIs); models were calculated adjusting for age and educational level. The existence of linear trend was examined using the Wald test. We used the deviation contrast method for regional inequalities to compare each category of the predictor variable to the un-weighted average for all groups, without defining a reference category (128).

All analyses were stratified by sex.

4 Articles

4.1 Article 1: Visual impairment and blindness in Spanish adults: geographic inequalities are not explained by age or educational level

Rius A, Artazcoz L, Guisasola L, Benach J. Visual impairment and blindness in spanish adults: geographic inequalities are not explained by age or education. *Ophthalmology*. 2014 Jan;121(1):408-16.

Rius A, Artazcoz L, Guisasola L, Benach J. Visual impairment and blindness in spanish adults: geographic inequalities are not explained by age or education. Ophthalmology. 2014 Jan;121(1):408-16. doi: 10.1016/j.ophtha.2013.07.017.

4.2 Article 2: Understanding the mechanism of gender inequalities in the prevalence of visual impairment in a high-income country

Understanding the mechanism of gender inequalities in the prevalence of visual impairment in a high-income country

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ABSTRACT

Objective: The objectives of this study were to analyse gender inequalities in the prevalence of blindness and visual impairment, age of onset, diagnosed and undiagnosed status, and related eye diseases among visually impaired individuals.

Design: Data were obtained from the 2008 Spanish Survey on "Disability, Personal Autonomy and Dependency Situations", a cross-sectional survey of a representative sample of the non-institutionalized population of Spain.

Participants: The sample was composed of 213,626 participants aged ≥15 years (103,093 men and 110,533 women); 360 were blind (160 men and 200 women), and 5,560 had some visual impairment (2,025 men and 3,535 women).

Methods: The prevalence of blindness and visual impairment, age of onset of visual impairment, and diagnosed and undiagnosed eye diseases was calculated. Multiple logistic regression models were fitted and odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for sex (women compared to men). All analyses were stratified by age group at the time of interview and age of onset of visual impairment.

Main outcome measures: Data on visual impairment, blindness, age of onset and diagnosed eye diseases were collected via interview.

Results: Women were more likely to report visual impairment [crude OR=1.6 (95% CI:1.56-1.74)]. Among people with visual impairment, the prevalence of undiagnosed eye disease was higher among men [crude OR=0.7 (95% CI: 0.64-0.81)]. Among visually impaired people with a diagnose, cataract was more common among women [crude OR=1.4 (95% CI: 1.25-1.67)], while glaucoma was more common among men

[(aORsex=0.8 (95% CI: 0.65-0.93)]. These trends were not explained by age or educational level.

Conclusions: Visual impairment is more common among women, which could be partly related to gender inequalities in access to health care. In contrast, the higher prevalence of glaucoma as a cause of visual impairment among men could be related to their less frequent and effectively use of health care services, which is related to their gender socialization.

INTRODUCTION

Blindness and low vision are widely recognized as a global public health problem and as important causes of impairment (1,2). It is estimated that 32.4 million people were blind in 2010 (60% women), and 191 million had moderate or severe visual impairment (57% women) (3). The cost of visual impairment is estimated at about $3 trillion per year worldwide, and this burden is expected to increase by approximately 20% within 10 years (4). Globally, visual impairment is generally more prevalent among women, regardless of age (5,6), with the female/male prevalence ratio estimated to be 1.1 to 1.5 in 2010 (3).

The prevalence of blindness and visual impairment is also higher among women in high-income countries, regardless of age (7–10), although the mechanisms that produce these gender inequalities are not well understood. Gender inequalities could be the result of gender differences in incidence or in the causes that drive the upward trend in prevalence, or they could be related earlier onset of visual impairment among women, with a resulting cumulative effect.

Gender inequalities can operate through different mechanisms in women and men, including access barriers to health care services (11) and lower treatment effort (12–15) among women, and help-seeking behaviour resulting in delayed diagnosis and treatment among men. Women are generally more likely to use health care services (15), and a growing body of evidence from gender-specific studies highlights the tendency among men to delay seeking help when they become ill. Social norms regarding traditional masculinity constrain help-seeking among men, mainly due to their attributed role of self-sufficiency and restrained emotional expressivity, influencing their perception of symptoms and weakness (16–18). For example, an Australian study found that women were more likely to use optometrist services, a fact that was not explained by incidence or barriers to access, but probably by differences in their attitude to when and how to seek health services (19). Among men, delayed diagnosis and poorer prognoses of some types of visual impairment may be due to their reluctance to use health care services.

Examining gender differences in visual impairment according to current age, age of onset, the diagnosed or undiagnosed reason of visual impairment, and the causes of blindness and visual impairment among people with a diagnosis could contribute to the better understanding of the mechanism that underlie gender inequalities in blindness and visual impairment.

Thus, the objectives of this study were to analyse gender inequalities in: 1) the prevalence of blindness and visual impairment; 2) the age of onset of visual impairment; 3) the prevalence of diagnosed and undiagnosed eye disease among visually impaired people; and 4) the cause of blindness or visual impairment among people with a diagnosis.

METHODS

Sample

Data were obtained from the 2008 Spanish Survey on "Disability, Personal Autonomy and Dependency Situations", a cross-sectional survey based on a representative sample of the non-institutionalized population of Spain. The methods of the survey are described elsewhere (20). The questionnaire included self-reported information on visual impairment and socio-demographic data. The sample was selected using a multi-stage random sampling strategy. The first- and second stage units were census tracts and family households, respectively. One adult aged ≥15 years was selected from each household to complete the questionnaire. A total of 213,626 people were interviewed (103,093 men and 110,533 women). Data were collected through face-to-face interviews at home between November 2007 and February 2008. Response rate was 96.1%, 64.6% of individuals were those initially selected and the rest were replaced (Ministerio de Sanidad y Consumo, 2006). Once a household was selected, failed initial attempts to contact the interviewee were followed up with several additional attempts before replacing households where all attempts failed. For the purpose of this study, the sample was restricted to people aged ≥15 years.

Measures

Vision outcomes

The diagnosis of visual impairment was based on three questions focused on blindness, near visual impairment, and distance visual impairment. To determine the severity of visual impairment, the following question was asked: "Are you blind or only able to differentiate between light and

darkness?" Information on visual impairment was elicited using the following questions: "Do you have significant difficulty reading newspaper print, even when wearing spectacles or contact lenses?" and "Do you have significant difficulty recognizing someone across the street (four meters distance), even when wearing glasses or contact lenses?" Blind individuals, and those with near or distance visual impairment were classified as having "some visual impairment". The classification for blindness and visual impairment used in the Survey follows the International Classification of Impairments, Disabilities and Handicaps (ICIDH).

Respondents who were blind or had some visual impairment were asked, "Have you been diagnosed with any of the following illnesses? (cataract, diabetic retinopathy, glaucoma, macular degeneration), and those who responded affirmatively were classified as having been diagnosed with each specific eye disease. Individuals who responded that they had never being diagnosed with these diseases (representing 90% of blindness in Europe) (1) nor with myopia magna or retinitis pigmentosa were classified as undiagnosed.

Predictor variables

Age groups were constructed as follows: <25 (16 to 24) years, 25 to 64 years, 65 to 79 years, and ≥80 years.

To detect congenital and perinatal conditions, data were collected on the age of onset of visual impairment, and were categorised as follows: ≤2 years, 3 to 24 years, 25 to 64 years, 65 to 79 years, and ≥80 years.

A four-category co variable for educational level was constructed, as follows: 1) illiterate (unable to read or write), 2) incomplete primary education), 3) complete primary education (or equivalent) and 4)

secondary or higher (including first and second stage secondary education, intermediate and higher vocational studies, and university degree or equivalent). As a measure of individual socioeconomic position an eight-category co variable was included in the analysis depending on the level attained within the Spanish education system.

Statistical analysis

The prevalence of blindness, visual impairment, diagnosed and undiagnosed eye disease, and age of onset of visual impairment were calculated for each gender, and also separately for each age group and educational level. To test for gender differences in prevalence, multiple logistic regression models were fit and odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for sex (women compared to men), with men as the reference category. Model 1 was adjusted for age, and Model 2 for age and educational level. All analyses were stratified by age group at the time of the interview and binary educational level (Table 3), and were carried out using SPSS v17.0.

RESULTS

Description of the sample

The results of a descriptive analysis of the sample are shown in Table 1. In both sexes the prevalence of visual impairment and blindness was higher among individuals over 65 years, and those with an incomplete primary education or who were illiterate. Gender differences ($p< 0.001$) in the prevalence of visual impairment and blindness were observed for age, educational level, age of onset, diagnosed eye diseases for blindness and diagnosed status for visual impairment.

Gender inequalities in the prevalence of visual impairment but not blindness

The prevalence of visual impairment was generally higher among women than men [age adjusted OR=1.4 (95% CI:1.30-1.46)] (Table 2); this observation was not fully explained by age or educational level. The overall prevalence of blindness was 0.2 % and no significant differences were observed between men and women [OR=1.2 (95% CI: 0.95-1.44)] (Table 3).

Gender inequalities by age group and age of onset of visual impairment

Among individuals over 24 years, the prevalence of visual impairment was higher among women than men (Table 2), and this gender difference became more marked in the >65 years age group; again, this observation was not explained by age within the age group or by educational level. However, we observed no notable increase in visual impairment in the ≥80 years group compared to the 65 to 80 years group. No significant gender differences were observed for blindness (Table 3). Gender differences did not vary markedly after adjusting for age and educational level (Table 2).

Men were more likely to become visually impaired [(ORsex=0.7 (95% CI: 0.56-0.89)] or blind [(ORsex=0.4 (95% CI: 0.19-0.76)] earlier in life (before age 2 years), and women later in life [65 to 79 years: ORsex=1.4 (95% CI: 1.18-1.60), and ORsex=1.8 (95% CI: 1.11-2.99), respectively] (Table 2 and 3). Gender differences were partly explained by variation in age within each age group.

Gender inequalities in the prevalence of diagnosed and undiagnosed eye disease

Among individuals with some visual impairment, men (39.8%) were more likely than women (32.3%) to report that they had not been diagnosed with

eye disease, and this differences was not explained by age or educational level [OR=0.8 (95% CI: 0.71-0.90)] (Table 2). No gender differences were observed for blindness (Table 3).

Gender inequalities in the cause of blindness or visual impairment

Among visually impaired individuals who had been diagnosed with eye disease, the prevalence of cataracts was significantly higher among women [age and educational level adjusted OR=1.3 (95% CI: 1.08-1.47)], whereas glaucoma was more prevalent among men [(ORsex=0.8 (95% CI: 0.66-0.95)], and these differences were not explained by age or educational level (Table 2). The prevalence of other diagnoses was also higher among women after adjustment for age (ORsex=1.2 (95% CI: 1.02-1.51)]. We observed no gender differences among diagnosed blind individuals in the prevalence of eye disease, except for glaucoma [(ORsex=0.5 (95% CI: 0.28-0.86)] (Table 3).

DISCUSSION

This study produced three main findings: 1) the prevalence of visual impairment was higher among women (after age 24 years) and increased with age; we observed no gender differences in the prevalence of blindness; 2) undiagnosed eye disease was more common among visually impaired men; 3) among visually impaired people with a diagnosed eye disease, cataracts and "other diagnoses" were more common among women, and glaucoma was more common among men.

This study was based on a large, representative sample of all regions of Spain, a high-income country, and for the first time we describing gender inequalities in the prevalence of undiagnosed eye diseases. Moreover, we were able to overcome some of the limitations of previous research

because this exceptionally large data set allowed us stratifying our analyses by sex, age, age of onset, diagnosis status, and eye disease, while controlling for gender differences in age and educational level. Finally, at the time of this study, Spain had free universal access to health care.

Gender inequalities in the prevalence of visual impairment

Our results are consistent with those of other studies reporting a higher prevalence of visual impairment among women (3,10). Since there is no evidence of gender differences in the incidence of visual impairment (21,22) or ocular diseases (23,24), and women are more likely to seek early health care assistance (19,25), these results may be partly due to gender inequalities in diagnosis or treatment effort. The Spanish National Health System offers free and universal eye care services for diagnosis and treatment of eye disease. However, of all surgeries and outpatient clinics in Spain, cataract surgery and outpatient ophthalmology visits have the longest waiting lists and the greatest number of waiting days (26). Among women, less intense therapeutic effort related to differences in waiting list prioritization as well as lower capacity to pay for private services could underlie the gender inequalities observed (12–14).

Visual impairment was more common in males aged ≥24 years, or who had become visually impaired or blind before 2 years of age. While childhood blindness and visual impairment is relatively rare compared to adult blindness, it remains a significant problem. In Europe, the prevalence of childhood blindness is between 0.1 and 0.4 per 1000 children (27). Biological factors such as preterm birth are associated with blindness and visual impairment among children (28), and boys born before 25 weeks gestation are more susceptible to visual impairment than girls (29). While gender differences have not been examined in detail, blindness and visual

impairment was found to be more prevalent among Swedish boys (30) which is consistent with our findings.

The absence of gender differences in blindness may be because the tendency among women to seek treatment earlier and be diagnosed earlier than men is compensated by the delay in treatment produced by their lower therapeutic effort (e.g. women wait almost twice as long as men to be operated, 2.9 and 1.73 months, respectively)(31). This effect, combined with long waiting lists for cataract surgery in Spain and the use of a relatively low mean Visual Acuity (VA) at which cataract surgery is indicated by ophthalmologists in Spain (mean VA=0,07 in Spain vs mean VA = 0.17 in Denmark) (32), could explain why gender inequalities tend to disappear as visual impairment deteriorates and becomes blindness.

Gender differences in the prevalence of non-diagnosed visual impairment

The traditional social model of hegemonic masculinity conditions men to control themselves, be active, strong, endure pain, and not seek help (33,34). This social model is associated with risky behaviors that are also linked to their lower life expectancy compared to women, including: difficulty in admitting that they have symptoms of body alarm,; postponing discomfort as it is experienced as an uncontrollable threat of his body, delaying attendance at health services because it is perceived as a failure of self-sufficiency; and poor adherence to treatment (16–18). For example, it has been reported that 41.7% of men in the US who reported visual impairment but did not seek care, indicated "no need" as the reason (combining responses "did not think of it" or "no reason to go (no problem)"), compared to 28.7% of women (25). These behaviors could explain the higher prevalence of non-diagnosis observed among visually impaired men (39.8% of men and 32.2% of women), and also explains the

increase rate of diagnosis among blind men (33.8% of men and 32.5% of women), when the impairment is not manageable.

Gender differences in the diagnosed causes of visual impairment

Cataract, which is a highly treatable ambulatory condition (35) that is provided free for Spanish citizens, was more common among visually impaired women than men (71.6% vs 63.6%), and accounted for most of the gender inequalities observed. These inequalities may be partly explained by less intense and delayed therapeutic effort among women, as described above (31). They may also be due to lower rates of surgery among women as in our results women are the 63,6% of the visually impaired and 68,9% of the diagnosed cataract, but according to Spanish data only represented the 56,2% of the ocular procedures and the 57,2% of the cataract surgeries reported in the public system (36).

Gender inequalities in the use of health care services related to gender socialization could explain the higher prevalence of glaucoma as the cause of visual impairment and blindness among men. According to multiple studies, approximately half of people with glaucoma are unaware of it, which is particularly worrying because glaucoma leads to irreversible loss of vision (37). Lowering intraocular pressure prevents loss of vision in patients with glaucoma and ocular hypertension (13,14), so most individuals with undiagnosed glaucoma could potentially benefit from treatment. Therefore, men's tendency to delay health care may ultimately cause them to develop advanced disease that can no longer be treated.

Limitations

While clinical examinations were not conducted in this study, previous studies support the validity of self-reported data on visual impairment when compared with visual acuity measurements (38,39). Nonetheless, a

higher sensitivity between low visual acuity and self-reported visual impairment is found among women (40), which could again be associated with traditional masculinity, in that men are more likely to deny their impairment when interviewed. This could lead us to underestimate the prevalence of visual impairment among men.

The variable for undiagnosed eye disease included individuals who were not diagnosed with cataract, diabetic retinopathy, glaucoma and macular degeneration (representing 90% of blindness in Europe) (1), as well as myopia magna and retinitis pigmentosa. However, gender differences in other, uncommon, eye diseases could partly explain the gender inequalities observed, although we found no evidence of this.

In conclusion, we observed strong gender inequalities in visual impairment in Spain, with a higher prevalence of visual impairment and related cataracts among women, and undiagnosed eye disease and related glaucoma among men. These results may be due to economic barriers to health care access, and less intense treatment effort among women, as well as delayed diagnosis and treatment among men due to delayed help-seeking behaviour. These results highlight the need to implement policies to reduce gender inequalities in the prevalence of visual impairment and blindness related to health care access. Moreover, awareness campaigns and programs focused on detecting visual impairment and related eye disease among men is recommended. More research is needed to clarify the potential economic reasons for the gender inequalities observed, and the role of long waiting lists on these gender inequalities remains unclear. Finally, further actions should be implemented to sensitize health

professionals to gender inequalities in therapeutic effort regarding eye disease.

TABLES

Table 1. General description of the sample (in percentages). *Survey on Disability, Personal Autonomy and Dependency*, 2008.

Variables	Total Population			Blindness			Some Visual Impairment		
	Males (%) N=103,093	Females (%) N=110,533	p-value*	Males (%) N = 160	Females (%) N = 200	p-value*	Males (%) N = 2025	Females (%) N = 3535	p-value*
Age group (years)			< 0.001			0.004			< 0.001
16-24	12.8	11.5		3.8	1.0		1.6	0.8	
25-64	67.9	65.2		26.9	18.0		32.8	23.8	
65-79	14.9	16.4		34.4	28.5		36.5	36.6	
≥80	4.4	6.8		35.0	52.5		29.0	38.8	
Educational level			< 0.001			0.003			< 0.001
Illiterate	1.8	3.7		12.0	24.2		8.1	16.7	
Less than Primary	13.5	15.9		34.6	35.4		36.8	39.4	
Complete Primary	27.9	26.6		28.3	27.3		31.2	28.3	
Secondary or higher	56.9	53.8		25.2	13.1		23.9	15.5	

* Chi-squared test/Fisher's exact test comparing distribution among men compared to women

Table 2. Crude Prevalence, OR, Adjusted OR and 95% Confidence Interval (CIs) for gender inequalities in the prevalence of some visual impairment, and diagnosed and undiagnosed eye diseases. *Survey on Disability, Personal Autonomy and Dependency*, 2008.

SOME VISUAL IMPAIRMENT

	Prevalence %			ORc (IC 95%)			ORa (IC 95%) Model 1 Adjusted for Age			ORa (IC 95%) Model 2 Adjusted for educational level			ORa (IC 95%) Model 3 Adjusted for age and educational level		
	Men	Women	p-value*	OR	95% CI	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value
Total	2.0	3.2		1.6	(1.56, 1.74)	< 0.001	1.4	(1.30, 1.46)	< 0.001	1.5	(1.46, 1.63)	< 0.001	1.3	(1.27, 1.42)	< 0.001
Age group															
16-24	0.3	0.2		0.9	(0.51, 1.41)	0.526	0.9	(0.51, 1.42)	0.543	1.0	(0.59, 1.64)	0.98	1.0	(0.61, 1.71)	0.93
25-64	1.0	1.2		1.2	(1.11, 1.36)	< 0.001	1.2	(1.10, 1.35)	< 0.001	1.2	(1.12, 1.37)	< 0.001	1.2	(1.08, 1.33)	0.001
65-79	4.8	7.1		1.5	(1.39. 1.67)	< 0.001	1.5	(1.36, 1.64)	< 0.001	1.4	(1.32, 1.59)	< 0.001	1.4	(1.31, 1.58)	< 0.001
≥80	13.0	18.2		1.5	(1.35, 1.66)	< 0.001	1.4	(1.25, 1.54)	< 0.001	1.5	(1.34, 1.65)	< 0.001	1.4	(1.24, 1.53)	< 0.001
Age of onset[a]			< 0.001												
<3	12.6	8.5		0.7	(0.56, 0.89)	0.003	1.0	(0.77, 1.27)	0.941	0.7	(0.57, 0.89)	0.003	1.0	(0.77, 1.28)	0.962
3-24	11.1	9.1		0.9	(0.69, 1.11)	0.264	1.2	(0.90, 1.48)	0.249	0.9	(0.70, 1.11)	0.277	1.2	(0.91, 1.48)	0.243
25-64	38.4	34.6		1.0	(0.84, 1.10)	0.55	1.0	(0.90, 1.19)	0.619	1.0	(0.84, 1.10)	0.556	1.0	(0.89, 1.17)	0.74
65-79	25.9	31.4		1.4	(1.18, 1.60)	< 0.001	1.2	(1.00, 1.36)	0.058	1.3	(1.10, 1.49)	0.002	1.1	(0.98, 1.33)	0.101
≥80	11.9	16.4		1.5	(1.25, 1.89)	< 0.001	1.0	(0.78, 1.28)	0.987	1.5	(1.24, 1.88)	< 0.001	1.0	(0.78, 1.28)	0.982
Diagnosis status[a]			< 0.001												
Diagnosed eye disease	60.2	67.8		1.4	(1.24, 1.56)	< 0.001	1.3	(1.11, 1.40)	< 0.001	1.4	(1.24, 1.56)	< 0.001	1.3	(1.12, 1.41)	< 0.001
Undiagnosed eye disease	39.8	32.3		0.7	(0.64, 0.81)	< 0.001	0.8	(0.71, 0.90)	< 0.001	0.7	(0.64, 0.81)	< 0.001	0.8	(0.71, 0.90)	< 0.001
Diagnosed eye disease[b,c]			< 0.001												
Cataract	63.6	71.6		1.4	(1.25, 1.67)	< 0.001	1.3	(1.08, 1.47)	0.003	1.4	(1.24, 1.66)	< 0.001	1.3	(1.08, 1.47)	0.003
Glaucoma	19.4	15.7		0.8	(0.65, 0.93)	0.006	0.8	(0.66, 0.95)	0.011	0.8	(0.65, 0.93)	0.006	0.8	(0.66, 0.95)	0.011
Macular degeneration	8.9	10.6		1.2	(0.96, 1.54)	0.108	1.1	(0.89, 1.43)	0.317	1.2	(0.96, 1.54)	0.105	1.1	(0.89, 1.44)	0.304
Diabetic retinopathy	13.2	13.6		1.0	(0.85, 1.27)	0.737	1.1	(0.87, 1.32)	0.500	1.0	(0.83, 1.24)	0.909	1.0	(0.85, 1.28)	0.685
Other diagnosis	16.2	16.2		1.0	(0.83, 1.21)	1.000	1.2	(1.02, 1.51)	0.035	1.0	(0.83, 1.21)	0.976	1.2	(1.01, 1.51)	0.036

[a] Visually impaired or blind individuals only
[b] Among diagnosed individuals with some visual impairment
[c] Note that individuals can have more than one diagnosed eye disease
* Chi-squared test/Fisher's exact test comparing distribution among men and women

Table 3. Crude Prevalence, OR and 95% Confidence Interval (CIs) for gender inequalities in the prevalence of blindness, and diagnosed and undiagnosed eye diseases. Survey on Disability, Personal Autonomy and Dependency, 2008.

	BLINDNESS					
	Prevalence %			ORc (IC 95%)		
	Men	Women	p-value*	OR	95% CI	p-value
Total	0.2	0.2		1.2	(0.95, 1.44)	0.148
Age group						
16-24	0.1	0.0		0.3	(0.07, 1.71)	0.193
25-64	0.1	0.1		0.8	(0.52, 1.27)	0.357
65-79	0.4	0.3		0.9	(0.61, 1.27)	0.490
≥80	1.2	1.4		1.1	(0.82, 1.57)	0.451
Age of onset[a]			0.001			
<3	16.5	6.6		0.4	(0.19, 0.76)	0.007
3-24	8.6	11.2		1.4	(0.68, 2.87)	0.362
25-64	38.8	29.1		0.7	(0.44, 1.06)	0.092
65-79	20.4	31.1		1.8	(1.11, 2.99)	0.017
≥80	15.8	21.9		1.6	(0.90, 2.69)	0.117
Diagnostic status[a]			0.822			
Diagnosed eye disease	66.3	67.5		1.1	(0.68, 1.65)	0.802
Undiagnosed eye disease	33.8	32.5		1.0	(0.61, 1.47)	0.802
Diagnosed eye diseases[b.c]			< 0.001			
Cataract	50.0	58.5		1.4	(0.85, 2.35)	0.188
Glaucoma	37.7	23.0		0.5	(0.28, 0.86)	0.013
Macular degeneration	9.4	17.8		2.1	(0.95, 4.56)	0.069
Diabetic retinopathy	18.9	20.7		1.1	(0.59, 2.13)	0.718
Other diagnosis	28.3	25.9		0.9	(0.50, 1.57)	0.680

[a] Blind individuals only
[b] Among blind individuals with diagnosed eye disease
[c] Note that individuals can have more than one diagnosed eye disease
* Chi-squared test/Fisher's exact test comparing distribution among men and women.

REFERENCES

1. Resnikoff S, Pascolini D, Etya'ale D, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004;82:844–51.
2. World Health Organization (WHO). Prevention of Avoidable blindness and visual impairment: WHA62.1.p. 1–30.
3. Stevens GA, White RA, Flaxman SR, et al. Global prevalence of vision impairment and blindness: magnitude and temporal trends, 1990-2010. Ophthalmology. 2013 Dec;120(12):2377–84.
4. Gordois A, Cutler H, Pezzullo L, et al. An estimation of the worldwide economic and health burden of visual impairment. Global Public Health. 2012. p. 465–81.
5. Muñoz B, West S, Rodriguez J, et al. Blindness, visual impairment and the problem of uncorrected refractive error in a Mexican-American population: Proyecto VER. Investig Ophthalmol Vis Sci. 2002;43:608–14.
6. Rius A, Guisasola L, Sabidó M, et al. Prevalence of visual impairment in El Salvador: inequalities in educational level and occupational status . Rev Panam Salud Publica. 36(5):290–9.
7. Evans J, Fletcher A, Wormald R, et al. Prevalence of visual impairment in people aged 75 years and older in Britain: results from the MRC trial of assessment and management of older people in the community. Br J Ophthalmol. 2002;86(7):795–800.
8. The Eye Diseases Prevalence Research Group. Causes and Prevalence of Visual Impairment Among Adults in the United States. Arch Ophthalmol. 2004;122:477–85.
9. Rodriguez J, Sanchez R, Munoz B, et al. Causes of Blindness and Visual Impairment in a Population-based Sample of U.S. Hispanics. Ophthalmology. 2002;109(4):737–43.
10. Abou-Gareeb I, Lewallen S, Bassett K, Courtright P. Gender and blindness: a meta-analysis of population-based prevalence surveys. Ophthalmic Epidemiol. 2001;8:39–56.
11. Lewallen S, Mousa A, Bassett K, Courtright P. Cataract surgical coverage remains lower in women. Br J Ophthalmol. 2009;93(3):295–8.
12. Ruiz-Cantero M, Verdú-Delgado M. Gender bias in treatment. Gac Sanit. 2004;18 Suppl 1:118–25.
13. Schaubel D, Stewart D, Morrison H, et al. Sex Inequality in Kidney Transplantation Rates. Arch Intern Med. 2000;160:2349–54.
14. Arber S, McKinlay J, Adams A, et al. Patient characteristics and inequalities in doctors' diagnostic and management strategies relating to CHD: A video-simulation experiment. Soc Sci Med. 2006;62:103–15.
15. Zhang X, Saaddine J, Lee PP, et al. Eye care in the United States: do we deliver to high-risk people who can benefit most from it? Arch Ophthalmol. 2007;125:411–8.
16. Möller-Leimkühler A. Barriers to help-seeking by men: A review of sociocultural and clinical literature with particular reference to depression. Journal of Affective Disorders. 2002. p. 1–9.

17. Galdas P, Cheater F, Marshall P. Men and health help-seeking behaviour: Literature review. Journal of Advanced Nursing. 2005. p. 616–23.
18. Addis M, Mahalik J. Men, masculinity, and the contexts of help seeking. Am Psychol. 2003;58:5–14.
19. Harris B, Sampson G. Gender differences in the utilisation of optometric services in Victoria. Cllinical Exp Optom. 2005;88(2):109–12.
20. Insituto Nacional de Estadística (INE). Survey on Disability, personal autonomy and dependency situations (AGE) 2007-2008. Methodology.
21. Klein R, Lee KE, Gangnon RE, Klein BEK. Incidence of visual impairment over a 20-year period: the Beaver Dam Eye Study. Ophthalmology. 2013;120(6):1210–9.
22. Hennis AJ, Wu S-Y, Nemesure B, et al. Nine-year incidence of visual impairment in the Barbados Eye Studies. Ophthalmology. 2009;116(8):1461–8.
23. Klein R, Lee KE, Gangnon RE, Klein BEK. The 25-year incidence of visual impairment in type 1 diabetes mellitus the wisconsin epidemiologic study of diabetic retinopathy. Ophthalmology. 2010;117(1):63–70.
24. Dimitrov P, Mukesh B, McCarty C, Taylor H. Five-Year Incidence of Bilateral Cause-Specific Visual Impairment in the Melbourne Visual Impairment Project. Invest Ophthalmol Vis Sci. 2003;44(12):5075–81.
25. Reasons for not seeking eye care among adults aged ≥40 years with moderate-to-severe visual impairment--21 States, 2006-2009. MMWR Morb Mortal Wkly Rep. 2011;60(19):610–3.
26. "Ministerio de Sanidad SS, e Igualdad". Sistema de información sobre listas de espera en el sistema nacional de salud. [Internet]. 2010 [cited 2014 Nov 26]. Available from: http://www.msssi.gob.es/estadEstudios/estadisticas/inforRecopilaciones/docs/ListaEsperaJunio10_CISNS.pdf
27. Kocur I, Resnikoff S. Visual impairment and blindness in Europe and their prevention. Br J Ophthalmol. 2002;86:716–22.
28. Arpino C, Compagnone E, Montanaro M, et al. Preterm birth and neurodevelopmental outcome: a review. Child's Nerv Syst. 2010;26(9):1139–49.
29. Jacobson L, Hård A, Horemuzova E, et al. Visual impairment is common in children born before 25 gestational weeks—boys are more vulnerable than girls. Acta Paediatr. 2009;98(2):261–5.
30. Blohmé J, Tornqvist K. Visual impairment in Swedish children. I. Register and prevalence data. Acta Ophthalmol Scand. 1997;75(2):194–8.
31. Quintana JM, Garcia S, Aguirre U, et al. Relationship of sociodemographic variables with outcomes after cataract surgery. Eye (Lond). 2013;27(6):698–707; quiz 708.
32. Norregaard JC, Bernth-Petersen P, Alonso J, et al. Variation in indications for cataract surgery in the United States, Denmark, Canada, and Spain: results from the International Cataract Surgery Outcomes Study. Br J Ophthalmol. 1998;82(10):1107–11.
33. Cameron E, Bernardes J. Gender and disadvantage in health: Men's health for a change. Sociol Health Illn. 1998;20:673–93.

34. Courtenay WH. Constructions of masculinity and their influence on men's well-being: A theory of gender and health. Soc Sci Med. 2000;50:1385–401.
35. Frick KD, Foster A. The magnitude and cost of global blindness: an increasing problem that can be alleviated. Am J Ophthalmol. 2003;135(4):471–6.
36. Conjunto Mínimo Básico de Datos – Ambulatorio (CMBD AAE). [Internet]. [cited 2015 Jan 20]. Available from: http://pestadistico.inteligenciadegestion.msssi.es/publicoSNS/comun/ArbolNodos.aspx
37. The Eye Diseases Prevalence Research Group. Prevalence of Open-Angle Glaucoma Among Adults in the United States. 2009;122(4):532–8.
38. Klein BE, Klein R, Lee KE, Cruickshanks KJ. Associations of performance-based and self-reported measures of visual function. The Beaver Dam Eye Study. Ophthalmic Epidemiol. 1999;6(1):49–60.
39. Laitinen A, Koskinen S, Härkänen T, et al. A nationwide population-based survey on visual acuity, near vision, and self-reported visual function in the adult population in Finland. Ophthalmology. 2005;112(12):2227–37.
40. Hiller R, Krueger DE. Validity of a survey question as a measure of visual acuity impairment. Am J Public Health. 1983;73(1):93–6.

4.3 Article 3: Exploring gender patterns for socioeconomic inequalities among visually impaired in a high-income country: what is the role of unmet need?

Exploring gender patterns for socioeconomic inequalities among visually impaired in a high-income country: what is the role of unmet need?

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ABSTRACT

Introduction: Socioeconomic position is associated with a higher prevalence of blindness and visual impairment although the mechanisms related to socioeconomic inequalities are not well understood.

Methods: Data were obtained from the 2008 Spanish Survey on "Disability, Personal Autonomy and Dependency Situations", a cross-sectional nationwide representative sample composed by 213,626 participants aged ≥15 years; 360 were blind, and 5,560 had some visual impairment. The prevalence of blindness and visual impairment were calculated and multiple logistic regression models for educational level were fitted.

Results: The prevalence of visual impairment and diagnosed cataract was higher among people of low educational level with no gender differences while prevalence of undiagnosed eye diseases was only higher among women. Prevalence of diagnosed glaucoma and macular degeneration was lower among low educational level diagnosed population.

Conclusion: A higher prevalence of visual impairment among less privileged people and diagnosed cataract among women was not explained with the lower use of health services but other barriers probable associated with a lower therapeutic effort. Conversely, a lower diagnostic effort among individuals with low educational level could explain the lower prevalence of diagnosed glaucoma and macular degeneration among them and highlight the need to improve the services and professionals attitudes.

INTRODUCTION

Socioeconomic position is associated with a higher prevalence of blindness and visual impairment (1,2) although the mechanisms involved are not

well understood. It could be the result of differences in incidence of eye diseases (3), although evidence is scarce and related to a greater exposure of eye diseases determinants (4,5). The higher prevalence of visual impairment among less privileged people could also be related to differences among the five types of unmet health care need (6), since socioeconomic and gender inequalities have been reported. Individuals reporting visual impairment and not accessing to eye care services could have an "unperceived need" related to the lack of eye care diseases information, "chosen unmet need" related to consciously deciding not seeking for help or "not chosen unmet need" related to economic or other barriers beyond their control. Once accessed to eye care services, diagnosed individuals could experience a "clinically validated unmeet need" and not receive the adequate treatment due to the low quality of services or inequalities in diagnosis and treatment effort (7,8). And, finally, a "subjective unmeet expectation" could merge when under patient's perception they don't receive the most suitable treatment. For example, a high prevalence of highly treatable eye conditions, as cataract, could be related to the lower access to treatment while glaucoma and macular degeneration could be associated with difficulties in diagnose and early detection.

The objectives of this study were to analyse socioeconomic inequalities in: 1) the prevalence of visual impairment; 2) the prevalence of diagnosed and undiagnosed eye disease among visually impaired people; 3); the diagnosed cause of visual impairment among people with a diagnosis; and 4) for all these objectives to examine the potential different gender patterns.

METHODS

Sample

Data were obtained from the 2008 Spanish Survey on "Disability, Personal Autonomy and Dependency Situations", a cross-sectional survey based on a representative sample of the non-institutionalized population of Spain.

Measures

Vision outcomes, diagnosis and un-diagnosis of eye diseases

The definition of some visual impairment was based on the following questions: "Do you have significant difficulty reading newspaper print, even when wearing spectacles or contact lenses?", "Do you have significant difficulty recognizing someone across the street (4 meters distance), even when wearing glasses or contact lenses?" and "Are you blind or only able to differentiate between light and darkness following the International Classification of Impairments, Disabilities and Handicaps (9). Respondents with some visual impairment were classified as when they answered positively the following question "Have you been diagnosed with any of the following illnesses?" for cataract, diabetic retinopathy, glaucoma and macular degeneration. Individuals who answered never being diagnosed of cataract, diabetic retinopathy, glaucoma, macular degeneration and additionally myopia magna and retinitis pigmentosa were classified as undiagnosed.

Predictor variables

Socioeconomic position was measured through educational level as a four-category co variable, according to the level attained according to the Spanish education system.

Statistical analysis

The prevalences of visual impairment, diagnosed and un-diagnosed eye diseases, as well as specific eye disease among diagnosed were estimated. All the analyses were stratified by educational level and sex. Multiple logistic regression models were used to calculate crude (ORc) and age-adjusted (aOR) odds ratios and 95% CIs. Data were analyzed using the R software (version 3.0.0). The existence of linear trend was examined using the Wald test.

RESULTS

Educational level inequalities in the prevalence of visual impairment

Table 1 shows the results of the descriptive analysis. The prevalence of visual impairment was higher among lower educational level population [men: aOR=3.0 (95% CI: 2.46-3.65); women: aOR=3.0 (95% CI: 2.59-3.39)] and a gradient was observed with similar gender patterns (Table 2).

Educational level inequalities in the prevalence of undiagnosed eye disease

The prevalence of non-diagnosed eye diseases among visually impaired was higher among illiterate women [aOR=1.3 (95% CI: 1.00-1.71)] but there were no differences among men [aOR=1.3 (95% CI: 0.92-1.96)]

Educational level inequalities in the prevalence of diagnosed eye diseases

Among visually impaired individuals who were diagnosed with eye disease, a higher prevalence of diagnosed cataract [OR=1.7 (95% CI: 1.19-2.37)] and diabetic retinopathy [OR=2.5 (95% CI: 1.52-4.04)] and a gradient among low educational level was observed only among women. A conversely educational level gradient with a lower prevalence of diagnosed glaucoma [men: OR=0.2 (95% CI: 0.07-0.45); women: OR=0.55 (95% CI: 0.36-0.85)] and macular degeneration [men: OR=0.2

(95% CI: 0.05-0.60); women: OR=0.25 (95% CI: 0.15-0.42)] was observed among diagnosed individuals with low educational level in both sexes.

DISCUSSION

This study produced four main findings: 1) the prevalence of visual impairment was higher among people of low educational level with no gender differences; 2) the prevalence of undiagnosed eye diseases was higher among women of low educational level but there were no differences among men; 3) the prevalence of diagnosed cataracts and diabetic retinopathy was higher among women of low educational level and a gradient was observed; and 4) in both sexes the prevalence of glaucoma and macular degeneration was lower among low educational level and a gradient was observed.

This study was based on a large and a representative sample of all regions of Spain, a high-income country. To our knowledge this is the first study that analyses reported non-diagnosis of eye diseases and the influence of each categories of unmet health care need. The exceptionally large data set allowed overcoming some of the limitations of previous research by firstly reporting sex disaggregated data among socioeconomic inequalities in a national-wide representative sample of high-income country.

Higher prevalence visual impairment among low educational level individuals not explained by non-diagnostic

The results are consistent with previous research reporting a higher prevalence of visual impairment among low educational level population and among women in high-income countries (11). Reasons could be related to a greater exposure to eye diseases determinants (5,12) resulting

in a higher incidence among low educational population (3) although the information is scarce. The dramatic reduction of social inequalities in non-diagnosed status (13) suggest that these inequalities are not explained to the lower use of health services among less privileged people but other barriers to accessing services probable associated with a lower therapeutic effort among the low socioeconomic status individuals.

Higher prevalence of cataract among women of low educational level

Cataract is an easily diagnosable condition and no clinical reason could explain the large educational level inequalities observed among women (17) who are diagnosed but not treated and for instance, are experiencing a clinician validated unmet need. Although in the Spanish health system cataract surgery is a free procedure, it has the longest waiting list and the greatest number of waiting days of all surgeries in Spain. This barrier could encourage the use of private services that would create inequalities related to individuals' ability to pay which differs among educational level groups (19). Additionally, a lower treatment effort of the eye health professionals among the less educated individuals and women (20,21), as observed in other health outcomes, could also be involved.

Higher prevalence of diabetic retinopathy among women of low educational level

Diabetes in Spain is associated with lower socioeconomic status, and is more prevalent among women which could be associated with a higher incidence of diabetic retinopathy and for instance with the higher prevalence of diagnosed diabetic retinopathy observed, although information is scarce.

Lower prevalence of diagnosed glaucoma and macular degeneration among individuals with low educational level.

Quality of eye care services and a lower diagnostic effort among individuals with low educational level could explain the lower prevalence of diagnosed glaucoma and macular degeneration among them (20,21)(22). It should be noted that, unlike cataracts, the diagnosis of glaucoma and macular degeneration is very demanding. Therefore, it is plausible that these demanding techniques were less used among people of lower socioeconomic position with visual impairment. The Spanish public health care system offers a universal and free eye care to the Spanish citizens but a long waiting list for outpatient ophthalmology visit are reported increasing the not chosen unmet need (18).

Limitations. The variable for undiagnosed eye disease included individuals who were not diagnosed with cataract, diabetic retinopathy, glaucoma and macular degeneration (representing 90% of blindness in Europe) (23) , as well as myopia magna and retinitis pigmentosa. However, gender differences in other, uncommon, eye diseases could partly explain the socioeconomic inequalities observed, although we found no evidence of this.

In conclusion, a higher prevalence of visual impairment among less privileged people and diagnosed cataract among women was not explained by a lower use of health services but with other barriers probably associated with a lower therapeutic effort. A lower diagnostic effort among individuals with low educational level could also explain the lower prevalence of diagnosed glaucoma and macular degeneration among them. These results highlight the need to implement policies to reduce socioeconomic inequalities related to eye care access and professionals attitudes.

TABLES

Table 1. General description of the sample (in percentages). *Survey on Disability, Personal Autonomy and Dependency*, 2008.

Variables	Total Population			Blindness			Some Visual Impairment		
	Males (%) N=103,093	Females (%) N=110,533	p-value*	Males (%) N = 160	Females (%) N = 200	p-value*	Males (%) N = 2025	Females (%) N = 3535	p-value*
Age group (years)			< 0.001			0.004			< 0.001
16-24	12.8	11.5		3.8	1.0		1.6	0.8	
25-64	67.9	65.2		26.9	18.0		32.8	23.8	
65-79	14.9	16.4		34.4	28.5		36.5	36.6	
≥80	4.4	6.8		35.0	52.5		29.0	38.8	
Educational level			< 0.001			0.003			< 0.001
Illiterate	1.8	3.7		12.0	24.2		8.1	16.7	
Less than Primary	13.5	15.9		34.6	35.4		36.8	39.4	
Complete Primary	27.9	26.6		28.3	27.3		31.2	28.3	
Secondary or higher	56.9	53.8		25.2	13.1		23.9	15.5	

* Chi-squared test/Fisher's exact test comparing distribution among men compared to women

Table 2. Crude Prevalence. OR and Adjusted OR and 95% Confidence Interval (CIs) for educational level inequalities in the prevalence of visual impairment, diagnosed and undiagnosed eye diseases Stratified by sex. Survey on Disability. Personal Autonomy and Dependency Situations 2008.

			Men						Women					
	Prevalence %		ORc (IC 95%) Crude			ORa (IC 95%) Model 2 Adjusted for age			ORc (IC 95%) Crude			ORa (IC 95%) Model 2 Adjusted for age		
	Men	Women	OR	95% CI	P-value	aOR	95% CI	P-value	OR	95% CI	P-value	aOR	95% CI	P-value
Visual impairment	1.96% (n=2022)	3.19% (n=3527)												
Illiterate	9.0	14.4	11.9	(9.93, 14.34)	< 0.001	3.0	(2.46, 3.65)	< 0.001	18.1	(16.04, 20.43)	< 0.001	3.0	(2.59, 3.39)	< 0.001
Less than Primary	5.3	7.9	6.8	(6.02, 7.60)	< 0.001	1.9	(1.65, 2.13)	< 0.001	9.3	(8.38, 10.24)	< 0.001	1.8	(1.59, 1.99)	< 0.001
Complete Primary	2.2	3.4	2.7	(2.40, 3.04)	< 0.001	1.3	(1.19, 1.52)	< 0.001	3.8	(3.39, 4.19)	< 0.001	1.3	(1.20, 1.50)	< 0.001
Secondary or more	0.8	0.9	1.0[d]			1.0[d]			1.0[d]			1.0[d]		
Non-diagnosed status[a]	39.86% (n=806)	32.29% (n=1139)												
Illiterate	41.5	32.4	1.0	(0.67, 1.34)	0,806	1.3	(0.92, 1.96)	0,126	0.7	(0.59, 0.95)	0.019	1.3	(1.00, 1.71)	0,049
Less than Primary	35.0	29.3	0.7	(0.57, 0.92)	0,008	1.2	(0.89, 1.50)	0,269	0.6	(0.53, 0.80)	< 0.001	1.1	(0.90, 1.43)	0,300
Complete Primary	43.1	32.7	1.0	(0.81, 1.30)	0,856	1.3	(1.01, 1.68)	0,038	0.8	(0.61, 0.94)	0.012	1.1	(0.91, 1.45)	0,259
Secondary or more	42.6	39.1	1.0[c]			1.0			1.0[c]			1.0		
Cataract[b]	63.6% (n=773)	71.6% (n=1709)												
Illiterate	69.8	77.2	2.0	(1.22, 3.28)	0.006	1.3	(0.76, 2.17)	0.354	3.0	(2.12, 4.17)	< 0.001	1.7	(1.19, 2.37)	0.003
Less than Primary	70.0	76.3	2.0	(1.49, 2.74)	< 0.001	1.1	(0.81, 1.60)	0.468	2.9	(2.23, 3.75)	< 0.001	1.6	(1.19, 2.13)	0.002
Complete Primary	61.0	70.7	1.4	(0.99, 1.86)	0.061	1.0	(0.72, 1.42)	0.949	2.2	(1.65, 2.84)	< 0.001	1.4	(1.03, 1.86)	0.031
Secondary or more	53.6	52.7	1.0[d]			1.0			1.0[d]			1[c]		
Diabetic retinopathy[b]	13.2% (n=161)	13.7% (n=326)												
Illiterate	8.3	16.5	0.5	(0.22, 1.07)	0.072	0.6	(0.26, 1.30)	0.184	2.0	(1.27, 3.18)	0.003	2.5	(1.52, 4.04)	< 0.001
Less than Primary	11.6	15.6	0.7	(0.46, 1.07)	0.097	0.9	(0.56, 1.40)	0.597	1.9	(1.24, 2.82)	0.003	2.3	(1.48, 3.60)	< 0.001
Complete Primary	14.8	11.5	0.9	(0.60, 1.42)	0.711	1.0	(0.67, 1.62)	0.863	1.3	(0.84, 2.04)	0.231	1.5	(0.97, 2.45)	0.066
Secondary or more	15.8	9.0	1.0			1.0			1.0[c]			1[d]		
Glaucoma[b]	19.3% (n=235)	15.7% (n=376)												
Illiterate	5.2	11.5	0.18	(0.07, 0.47)	< 0.001	0.17	(0.07, 0.45)	< 0.001	0.50	(0.33, 0.75)	0.001	0.55	(0.36, 0.85)	0.007
Less than Primary	18.6	15.0	0.77	(0.53, 1.10)	0.147	0.71	(0.48, 1.05)	0.089	0.68	(0.49, 0.93)	0.015	0.75	(0.53, 1.06)	0.098
Complete Primary	21.2	17.0	0.90	(0.62, 1.31)	0.576	0.87	(0.59, 1.27)	0.462	0.79	(0.56, 1.09)	0.153	0.85	(0.60, 1.20)	0.359
Secondary or more	23.0	20.7	1.0[c]			1.0[c]			1.0[c]			1.0[c]		
Macular degeneration[b]	9.0% (n=109)	10.7% (n=255)												
Illiterate	3.1	6.8	0.24	(0.07, 0.80)	0.020	0.18	(0.05, 0.60)	0.006	0.39	(0.24, 0.64)	< 0.001	0.25	(0.15, 0.42)	< 0.001
Less than Primary	8.7	9.2	0.71	(0.44, 1.15)	0.159	0.50	(0.30, 0.83)	0.008	0.55	(0.38, 0.79)	0.001	0.35	(0.24, 0.52)	< 0.001
Complete Primary	8.6	12.8	0.70	(0.42, 1.18)	0.180	0.58	(0.34, 0.99)	0.044	0.80	(0.55, 1.16)	0.230	0.56	(0.38, 0.83)	0.004
Secondary or more	11.9	15.6	1.0			1.0[c]			1.0[d]			1.0[d]		

[a] Only for visually impaired population
[b] Only for visually impaired and diagnosed population
[c] Wald test with P <0.05.
[d] Wald test with P < 0.001.

REFERENCES

1. Salive ME, Guralnik J, Christen W, Glynn RJ, Colsher P, Ostfeld AM. Functional blindness and visual impairment in older adults from three communities. Ophthalmology. 1992 Dec;99(12):1840–7.
2. Guisasola L, Tresserras-Gaju R, García-Subirats I, Rius A, Brugulat-Guiteras P. [Prevalence and burden of visual impairment in Catalonia, Spain]. Med Clin (Barc). 2011;137 Suppl 22–6.
3. Klein R, Lee KE, Gangnon RE, Klein BEK. Incidence of visual impairment over a 20-year period: the Beaver Dam Eye Study. Ophthalmology. 2013 Jun;120(6):1210–9.
4. Centers for Disease Control and Prevention (CDC). Prevalence of visual impairment and selected eye diseases among persons aged >/=50 years with and without diabetes--United States, 2002. MMWR Morb Mortal Wkly Rep. 2004 Nov;53(45):1069–71.
5. Klein R, Lee KE, Gangnon RE, Klein BEK. Relation of Smoking, Drinking, and Physical Activity to Changes in Vision over a 20-Year Period. Ophthalmology. 2014 Jun;121(6):1220–8.
6. Allin S, Grignon M, Le Grand J. Subjective unmet need and utilization of health care services in Canada: what are the equity implications? Soc Sci Med. 2010 Feb;70(3):465–72.
7. Arber S, McKinlay J, Adams A, Marceau L, Link C, O'Donnell A. Patient characteristics and inequalities in doctors' diagnostic and management strategies relating to CHD: A video-simulation experiment. Soc Sci Med. 2006;62:103–15.
8. Zhang X, Beckles GL, Chou C-F, Saaddine JB, Wilson MR, Lee PP, et al. Socioeconomic Disparity in Use of Eye Care Services Among US Adults With Age-Related Eye Diseases: National Health Interview Survey, 2002 and 2008. JAMA Ophthalmol. 2013;131:1198–206.
9. Insituto Nacional de Estadística (INE). Survey on Disability, personal autonomy and dependency situations (AGE) 2007-2008. Methodology.
10. Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel G, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004;82:844–51.
11. Ulldemolins AR, Lansingh VC, Valencia LG, Carter MJ, Eckert K a. Social inequalities in blindness and visual impairment: a review of social determinants. Indian J Ophthalmol. 2011;60(5):368–75.
12. Myers CE, Klein BEK, Gangnon R, Sivakumaran TA, Iyengar SK, Klein R. Cigarette smoking and the natural history of age-related macular degeneration: the Beaver Dam Eye Study. Ophthalmology. 2014 Oct;121(10):1949–55.
13. Lee DJ, Arheart KL, Lam BL, Zheng D, Christ SL, McCollister KE, et al. Trends in reported visual impairment in United States adults. Ophthalmic Epidemiol. Jan;16(1):42–9.
14. Ryskulova A, Turczyn K, Makuc DM, Cotch MF, Klein RJ, Janiszewski R. Self-reported age-related eye diseases and visual impairment in the United States: Results of the 2002 National Health Interview Survey. Am J Public Health. 2008;98:454–61.

15. Reasons for Not Seeking Eye Care Among Adults Aged ≥40 Years with Moderate-to-Severe Visual Impairment --- 21 States, 2006--2009.
16. Noertjojo K, Maberley D, Bassett K, Courtright P. Awareness of eye diseases and risk factors: identifying needs for health education and promotion in Canada. Can J Ophthalmol / J Can d'Ophtalmologie. 2006 Oct;41(5):617–23.
17. Chang JR, Koo E, Agrón E, Hallak J, Clemons T, Azar D, et al. Risk factors associated with incident cataracts and cataract surgery in the Age-related Eye Disease Study (AREDS): AREDS report number 32. Ophthalmology. 2011 Nov;118(11):2113–9.
18. Conjunto Mínimo Básico de Datos – Ambulatorio (CMBD AAE). .
19. Anderson G, Black C, Dunn E, Alonso J, Christian-Norregard J, Folmer-Anderson T, et al. Willingness to pay to shorten waiting time for cataract surgery. Health Aff (Millwood). Jan;16(5):181–90.
20. Ruiz-Cantero M, Verdú-Delgado M. Gender bias in treatment. Gac Sanit. 2004;18 Suppl 1:118–25.
21. Arber S, McKinlay J, Adams A, Marceau L, Link C, O'Donnell A. Patient characteristics and inequalities in doctors' diagnostic and management strategies relating to CHD: A video-simulation experiment. Soc Sci Med. 2006;62:103–15.
22. Worley A, Grimmer-Somers K. Risk factors for glaucoma: what do they really mean? Aust J Prim Health. CSIRO PUBLISHING; 2011 Jan;17(3):233–9.
23. Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel GP, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004;82(11):844–51.

5 Discussion

5.1 Main results

Regional, gender and socioeconomic inequalities in the prevalence of visual impairment were observed in Spain, with a north-to-south gradient of increasing regional prevalence that was not explained by age or individual educational level, but which was correlated with regional level of economic development. We observed strong gender inequalities, with a higher prevalence of visual impairment and related cataracts among women, and undiagnosed eye disease and related glaucoma among men. We also observed socioeconomic inequalities, with a higher prevalence of visual impairment among less privileged people and of diagnosed cataract among women of low socioeconomic status. Conversely the prevalence of diagnosed glaucoma and macular degeneration was lower among individuals with low socioeconomic status.

This study confirms the existence of similar regional, socioeconomic and gender inequalities in visual impairment as those described for low income countries (71). These results highlight four main possible mechanisms, as described in sections 5.2 to 5.5.

5.2 Regional economic development related to quality of services as a contextual risk factor for visual impairment

We observe strong regional inequalities in visual impairment in Spain that are significantly negatively correlated with regional GDP, independently of individual factors, such as age and individual socioeconomic status. These results highlight the existence of contextual factors other than the proportion of individuals at greater risk of illness, and to reduce the regional differences would need to be addressed by policies (14). Regional differences in the quality of eye care services and the prevalence of diabetes (63) are highlighted and discussed below as contextual factors associated with regional inequalities that necessitate an improvement in eye care services and diabetes prevention campaigns in low income regions.

First, regional differences in the quality of eye care offered are suggested by regional differences in the proportion of non-diagnosed of eye disease, which is correlated with the regional prevalence of visual impairment, and inversely correlated with regional diagnosis rates reported by the Ministry of Health (129). Second, a clinically validated unmet need for individuals diagnosed with cataract but not treated (results not showed) was also correlated with the prevalence of visual impairment, and could be a

consequence of the length of waiting lists for cataract surgery and outpatient ophthalmology visits within the public health system (64), as we found no correlation between the official rates of cataract diagnosis and treatment among regions. These differences in health care outcomes between regions are likely permitted by the transfer of regional health policies on cover for eye care procedures, medical protocols and waiting list management. These policies may vary according to the regional GDP, as this could influence the prioritization of other policies for counteracting poverty, or could promote the existence and affordability of other private substitutive services that would not be affordable for low income groups.

Other contextual factor, such as regional prevalence of risk factors for eye diseases, like diabetes (57), which is more prevalent in southern regions of Spain (130), could be associated with the regional inequalities observed. Inequalities in the prevalence of diabetes could be related to diet, which is influenced by social and cultural factors, and varies greatly between regions. Diabetes risk is also associated with socioeconomic position, which varies between the regions of Spain (131).

Finally, differences in the incidence of visual impairment could be associated with higher incidence of cataract induced by greater ultraviolet light exposure and the rural environment of the south of Spain (60).

5.3 Traditional masculinity and its involvement in visual impairment

For the first time, these results show a higher prevalence of non-diagnosed visual impairment among men, which is not explained by the higher incidence of visual impairment or eye diseases among women (132–134). These results are consistent with men's lower tendency to seek eye care (105), and lower awareness of eye diseases and their risk factors (111), which are associated with the traditional masculinity role (23,24,35). This social model is associated with risky behaviors that are also linked to men's difficulty in admitting symptoms, as this is experienced as an uncontrollable threat, delaying attendance at health services because it is perceived as a failure of self-sufficiency, and poor adherence to treatment (24–26). In this sense, traditional masculinity can be considered a risk factor for men that leads to a higher prevalence not only of non-diagnosed visual impairment, but also of blindness due to advanced, untreatable glaucoma. These behaviors also explain the increased rate of diagnosis among blind men and the absence of gender inequalities in the prevalence of blindness, when the impairment is not manageable.

As a result of traditional hegemonic masculinity, men experience a higher unmet need for eye care treatment (135), related to either greater

'unperceived need', as they report less eye disease information, or 'chosen unmet need' due to consciously deciding not to seek help (41.7% of men and 28.7% of women who declared a visual impairment cited 'no need' as the main reason for not attending eye care services) (105).

5.4 Less treatment of cataract among women, especially those with low educational level

While non-diagnosed eye diseases are associated with low educational level among women, they also have a higher prevalence of diagnosed cataract. As our results only include diagnosed individuals, they capture 'clinician-validated unmet need', defined as individuals who accessed health care services but did not receive adequate treatment. Thus, 'unperceived need' related to the lack of eye care diseases information, '"chosen unmet need' related to consciously deciding not to seek help, and '"not chosen unmet need' related to economic or other barriers beyond the individual's control are not considered to be involve with the higher prevalence observed among women.

Cataract is an easily diagnosed (51), familiar condition (111), and it seems unlikely that the significant educational level and gender inequalities observed among individuals who are diagnosed but not treated could be explained by clinical reasons or help-seeking behavior. In contrast factors

related to the quality of services offered by the Spanish health system could be involved, since cataract surgery has the longest waiting list and the greatest number of waiting days of all surgeries in Spain, despite being a free procedure (136,137). This barrier may encourage the use of private services that would create inequalities related to individuals' ability to pay, which differs according to educational level and gender, especially in Spain (65). Lower treatment effort by eye health professionals among individuals with low educational level and women (32,34,102), as observed for other health outcomes, could also be involved. For example, women wait almost twice as long as men for cataract surgery within the National Health System in Spain (2.9 and 1.73 months, respectively) (138); also, women account for 68.9% of diagnosed cataract, but only 57.2% of cataract surgeries in the public system (137). Additionally, improvement in visual acuity after surgery was less significant among individuals with low socioeconomic position.

Finally, a higher incidence of cataracts among individuals with low educational level may also be involved (62), consistent with greater exposure to risk factors for cataract, such as UV light exposure (60), diabetes and smoking (62).

5.5 Non-diagnosis of glaucoma and age-related macular degeneration among low educational level individuals

While visual impairment is more common among individuals with low educational level, the prevalence of diagnosed glaucoma and AMD is lower in this group, as previously observed in the general population in the US (74). While less well educated individuals have greater exposure to risk factors (139) such as hypertension, smoking (55), obesity, diabetes (109), and physical activity (110), the lower prevalence of diagnosed glaucoma and macular degeneration observed in this group could be related to the quality of eye care services and lower diagnostic effort (34,102).

To our knowledge, little is known about differences in the incidence of glaucoma and AMD related to educational level. Previous work indicates that less well educated individuals have lower awareness of the disease (111), which could lead to differences in help-seeking behaviour, and could partly explain delayed and lower attendance to eye care services, resulting in lower diagnostic rates. Poorer ability to recognize symptoms and anamnesis among illiterate individuals could partly explain our results, since we observe higher rates of non-diagnosed glaucoma (75.7%) and AMD (90.1%) than of cataract (18.4%) among patients with dementia. Note that, unlike cataracts, glaucoma and macular degeneration are very

difficult to diagnose. Thus, it is plausible that the more sophisticated techniques required to diagnose these diseases were less used among visually impaired people with lower socioeconomic position.

Additionally, a higher association of low educational level was found among man compared to women for lower diagnosis of glaucoma [men: OR=0.2 (95% CI: 0.07-0.45); women: OR=0.55 (95% CI: 0.36-0.85)] and macular degeneration [men: OR=0.2 (95% CI: 0.05-0.60); women: OR=0.25 (95% CI: 0.15-0.42)] compared to illiterate women. Interaction between illiteracy and masculinity in diseases that are difficult to diagnose should be explored, as this has not been analyzed before. This could explain our results by an adding less help-seeking behaviour and poorer knowledge of eye disease to economic barriers among low educational level men (111).

5.6 Strengths and limitations

This study was based on a large, representative sample of all regions of Spain, and is one of the first country-wide population studies of visual impairment and blindness in a high-income country. This exceptionally large data set also allowed us to overcome some of the limitations of previous research by stratifying the analysis by sex, age of onset, diagnosis

status, and diagnosed eye disease, considering near and distance visual impairment separately, and controlling for potential differences in age and individual socioeconomic position.

As a limitation, subjects were asked to consider their level of vision 'even when wearing spectacles or contact lenses', but these responses may include uncorrected refractive errors, which are the most important cause of visual impairment worldwide (51). Similarly, the variable for undiagnosed eye disease included individuals who declared that they had not been diagnosed with cataract, diabetic retinopathy, glaucoma and macular degeneration (representing 90% of blindness in Europe) (78), as well as myopia magna and retinitis pigmentosa. However, other uncommon eye diseases related to inequalities could partly explain the results observed, although we found no evidence of this. Such biases could not be detected, measured or corrected for because clinical examinations were not conducted.

Nonetheless, previous studies support the validity of self-reported data on visual impairment when compared with visual acuity measurements (125,126). However, the sensitivity between low visual acuity and self-reported visual impairment is higher among women (127), which could be associated with traditional masculinity, in that men are more likely to deny

an impairment when interviewed. This could lead us to underestimate the prevalence of visual impairment among men.

The cross-sectional design of the survey precluded an analysis of internal migration patterns or population changes over the time. The fact that individuals who migrate tend to be healthier could contribute to the pattern of lower prevalence observed in the northern regions.

Finally, current economic crisis has a direct influence on patterns of inequality, which could affect the validity of the results in the present context. However, the current increase in waiting lists and cuts in health budgets does foresee a decrease in the quality of public services and lower capacity to pay substitutive private services, resulting in increase in the observed inequalities.

5.7 Contribution, future research and public health implications

This study has contributed to a better understanding of the mechanism that underlies the higher prevalence of blindness and visual impairment among women and individuals with low socioeconomic status, and the regional contextual factors involved in high-income countries. Its main contribution to current knowledge is to show for the first time that this higher prevalence is associated with factors related to unmet need for eye care

that are beyond the patient's control, such as quality of services, traditional masculinity, and therapeutic and diagnostic effort.

To our knowledge this is the first time that a nationally representative study has reported the prevalence of blindness, visual impairment and associated eye diseases in Spain. It is also the first report of on the role of age-of-onset of visual impairment and the diagnosis and non-diagnosis of eye diseases in relation to socioeconomic and gender inequalities.

These results highlight how policies aimed at improving the quality of eye care services and reducing waiting lists for cataract surgery and outpatient visits could influence the prevalence of visual impairment and blindness, and reduce regional, socioeconomic and gender inequalities. Health information systems should be improved in order to monitor social inequalities in visual impairment and blindness and facilitate reporting of differences in therapeutic and diagnostic effort among women and individuals with low socioeconomic status. More research is required to address questions raised by this study, for example, to determine the reasons for regional inequalities. We propose two areas of research on regional inequalities: first, the question of whether regional differences in the incidence of visual impairment persist after adjusting for exposure to risk factors such as smoking, diabetes or individual UV light exposure;

second, the question of whether the observed regional inequalities are associated with factors related to the quality of services, such as protocol differences in the criteria for cataract surgery, regional differences in diagnostic or therapeutic effort and the role of regional waiting lists. To assess the mechanism underlying the observed gender and socioeconomic inequalities, we propose four areas of research: first, evaluate whether there are gender and socioeconomic differences in the incidence of visual impairment and associated eye diseases independently of exposure to risk factors; second, gender and socioeconomic differences in therapeutic and diagnostic effort in the public system, and the use of substitutive private services; third, barriers associated with the role of hegemonic masculinity and educational level, and their effects on recognizing symptoms and attending eye care services; and four, evaluate whether non-diagnosed eye diseases among visually impaired individuals are associated with different categories of unmet need. Identifying the influence of the incidence of eye diseases, unmet health care needs, including help-seeking behavior and treatment and diagnostic effort, as well as the barriers that underlie the observed inequalities, would help in the development and implementation of more effective policies. Thus, we recommend the following preventive and curative strategies: first, homogenization across regions of protocols

and waiting lists for ophthalmic procedures within the public system, and the inclusion of the gender perspective with an emphasis on increasing cataract treatment among women; second, an emergency protocol and preventive campaigns should be designed to reduce the high rates of non-diagnosed eye diseases and delayed attendance among visually impaired individuals, with a gender perspective and specific recommendations for men.

Finally, steps should be taken to sensitize health professionals in preventing gender and socioeconomic inequalities in diagnosis and therapeutic effort related to eye diseases.

Therefore, actions is required to reduce the inequalities observed and avoid blaming victims or suggesting lower prioritization or lower attendance at health services.

6 Conclusions

We observed regional, gender and socioeconomic inequalities in the prevalence of visual impairment in Spain. A north-to-south gradient of increasing regional prevalence was observed, and was correlated with the level of regional economic development, which could be associated with contextual factors, such as quality of eye care services. We also observed strong gender inequalities with a higher prevalence of visual impairment and diagnosed cataracts among women, which could be related to lower therapeutic effort or economic barriers, and to undiagnosed eye disease and glaucoma related to traditional masculinity among men. Our results also showed notable socioeconomic inequalities, with a higher prevalence of visual impairment among less privileged people, which could be associated with higher incidence of eye diseases. A higher prevalence of diagnosed but untreated cataract among women of low socioeconomic status could be related to economic barriers or a double discrimination in therapeutic effort. The lower prevalence of diagnosed glaucoma and macular degeneration observed among individuals with low socioeconomic status could be related to lower diagnostic effort among them. In conclusion, the results of this work highlight the need to implement policies to reduce socioeconomic inequalities in access to eye care services, quality of services, and professionals' attitudes.

7 References

1. Whitehead M, Dahlgren G. Levelling up (part 1): a discussion paper on concepts and principles for tackling social inequities in health [Internet]. WHO. 2010 [cited 2014 Nov 11]. Available from: http://www.who.int/social_determinants/resources/leveling_up_part1.pdf

2. Whitehead M. The concepts and principles of equity and health. Int J Health Serv. 1992 Jan;22(3):429–45.

3. Oxfam. Gobernar para las élites: Secuestro democrático y desigualdad económica - bp-working-for-few-political-capture-economic-inequality-200114-es_0.pdf [Internet]. 2014 [cited 2014 Nov 13]. Available from: http://www.oxfam.org/sites/www.oxfam.org/files/bp-working-for-few-political-capture-economic-inequality-200114-es_0.pdf

4. WHO | Commission on Social Determinants of Health - final report. World Health Organization;

5. Bourdieu P (198). "The Forms of Capital." In J. Richardson. 1986.

6. "International Labour Organization-Conditions of Work and Employment Branch (TRAVAIL)." Global Wage Report 2012/13: Wages and Equitable Growth. 2012;

7. Woolf SH, Johnson RE, Phillips RL, Philipsen M. Giving everyone the health of the educated: an examination of whether social change would save more lives than medical advances. Am J Public Health. 2007 Apr;97(4):679–83.

8. Dorling, D. (2013). Unequal health: The Scandal of Our Times. Policy Press.

9. M Shaw, D Dorling, D Gordon GDS. The Widening Gap: health inequalities and policy in Britain. [Internet]. Bristol: Policy Press. 1999 [cited 2015 Sep 2]. Available from: http://www.dannydorling.org/?page_id=1460

10. "Comisión Para Reducir Las Desigualdades Sociales En Salud En España." [A proposal of policies and interventions to reduce social inequalities in health in Spain.Commission to Reduce Social Inequalities in Health in Spain]. Gac Sanit. 26(2):182–9.

11. "World Health Organization." Life expectancy at birth [Internet]. 2012 [cited 2014 Nov 12]. Available from: http://gamapserver.who.int/gho/interactive_charts/mbd/life_expectancy/atlas.html

12. The world Bank. Mortality rate, infant (per 1,000 live births) [Internet]. [cited 2015 Jul 13]. Available from: http://data.worldbank.org/indicator/SP.DYN.IMRT.IN/countries?display=map

13. Navarro V, Borrell C, Muntaner C, Benach J, Quiroga A, Rodríguez-Sanz M, et al. El Impacto de la Política en la Salud. Salud Colect. Universidad Nacional de Lanús; 3(1):9–32.

14. M Shaw, D Dorling, D Gordon GDS. Health, Place and Society [Internet]. [cited 2015 Sep 8]. Available from: http://www.dannydorling.org/wp-content/files/dannydorling_publication_id0984.pdf

15. Benach J, Yasui Y. Geographical patterns of excess mortality in Spain explained by two indices of deprivation. J Epidemiol Community Health. 1999 Jul;53(7):423–31.

16. Fernandez-Martinez B, Prieto-Flores M-E, Forjaz MJ, Fernández-Mayoralas G, Rojo-Pérez F, Martínez-Martín P. Self-perceived health status in older adults: regional and sociodemographic inequalities in Spain. Rev Saude Publica. 2012 Apr;46(2):310–9.

17. Espelt A, Borrell C, Roskam AJ, Rodríguez-Sanz M, Stirbu I, Dalmau-Bueno A, et al. Socioeconomic inequalities in diabetes mellitus across Europe at the beginning of the 21st century. Diabetologia. 2008 Nov;51(11):1971–9.

18. Bacigalupe A, Escolar-Pujolar A. The impact of economic crises on social inequalities in health: what do we know so far? Int J Equity Health. 2014 Jan;13:52.

19. López-Jaramillo P, Pradilla LP, Castillo VR, Lahera V. [Socioeconomic pathology as a cause of regional differences in the prevalence of metabolic syndrome and pregnancy-induced hypertension]. Rev española Cardiol. 2007 Feb;60(2):168–78.

20. Borrell C, Benach J. Evolució de les desigualtats en la salut a Catalunya [Internet]. Fundació Jaume Bofil. 2005 [cited 2015 Feb 6]. Available from: http://www.fbofill.cat/intra/fbofill/documents/publicacions/414.pdf

21. Rohlfs I, Borrell C, do C. Fonseca M. Género, desigualdades y salud pública: conocimientos y desconocimientos. Gac Sanit. Elsevier; 2000 Dec 1;14:60–71.

22. Cameron E, Bernardes J. Gender and disadvantage in health: Men's health for a change. Sociol Health Illn. 1998;20:673–93.

23. Courtenay WH. Constructions of masculinity and their influence on men's well-being: A theory of gender and health. Soc Sci Med. 2000;50:1385–401.

24. Addis M, Mahalik J. Men, masculinity, and the contexts of help seeking. Am Psychol. 2003;58:5–14.

25. Galdas P, Cheater F, Marshall P. Men and health help-seeking behaviour: Literature review. Journal of Advanced Nursing. 2005. p. 616–23.

26. Möller-Leimkühler A. Barriers to help-seeking by men: A review of sociocultural and clinical literature with particular reference to depression. Journal of Affective Disorders. 2002. p. 1–9.

27. Insituto Nacional de Estadística (INE). Panorámica de la discapacidad en España. [Internet]. 2009 [cited 2015 Feb 6]. Available from: http://www.ine.es/revistas/cifraine/1009.pdf

28. National Institute of Statistics; INE. Life expectancy at birth in Spain [Internet]. [cited 2015 Sep 8]. Available from: http://www.ine.es/jaxiT3/Tabla.htm?t=1414&L=1

29. Insituto Nacional de Estadística (INE). Boletín Informativo Febrero 2009 [Internet]. 2009 [cited 2015 Feb 6]. Available from: http://www.ine.es/revistas/cifraine/0209.pdf

30. Krieger N. Embodiment: a conceptual glossary for epidemiology. J Epidemiol Community Health. 2005 May;59(5):350–5.

31. Neugarten J, Silbiger SR. The impact of gender on renal transplantation. Transplantation. 1994 Dec 15;58(11):1145–52.

32. Schaubel D, Stewart D, Morrison H, Zimmerman D, Cameron J, Jeffrey J, et al. Sex Inequality in Kidney Transplantation Rates. Arch Intern Med. 2000;160:2349–54.

33. Heston TF, Lewis LM. Gender bias in the evaluation and management of acute nontraumatic chest pain. The St. Louis Emergency Physicians' Association Research Group. Fam Pract Res J. 1992 Dec;12(4):383–9.

34. Ruiz-Cantero M, Verdú-Delgado M. Gender bias in treatment. Gac Sanit. 2004;18 Suppl 1:118–25.

35. Courtenay WH. Constructions of masculinity and their influence on men's well-being: a theory of gender and health. Soc Sci Med. 2000 May;50(10):1385–401.

36. Borrell C, Artazcoz L. Inequalities gender on health: challenges for the future. Rev Esp Salud Publica. MSSSI; 82(3):241–9.

37. Hoffmann R, Eikemo TA, Kulhánová I, Dahl E, Deboosere P, Dzúrová D, et al. The potential impact of a social redistribution of specific risk factors on socioeconomic inequalities in mortality: illustration of a method based on population attributable fractions. J Epidemiol Community Health. 2013 Jan;67(1):56–62.

38. Muntaner C, Benach J. Aprender a mirar la salud. Cómo la desigualdad social daña nuestra salud. El Viejo Topo; 2005. 130 p.

39. Wilkinson R, Marmot M. Social determinants of Health. The solid facts. 2003.

40. Stirbu I. Inequalities in health, does health care matter? Social inequalities in mortality in Europe, with a special focus on the role of the health care system. 2008 Dec 5;

41. Nicol MB, Thrift AG. Knowledge of risk factors and warning signs of stroke. Vasc Health Risk Manag. 2005 Jan;1(2):137–47.

42. Eikemo TA, Hoffmann R, Kulik MC, Kulhánová I, Toch-Marquardt M, Menvielle G, et al. How can inequalities in mortality be reduced? A quantitative analysis of 6 risk factors in 21 European populations. PLoS One. 2014 Jan;9(11):e110952.

43. Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel G, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004;82:844–51.

44. World Health Organization (WHO). WHA62.1. Prevention of Avoidable blindness and visual impairment. p. 1–30.

45. Gordois A, Cutler H, Pezzullo L, Gordon K, Cruess A, Winyard S, et al. An estimation of the worldwide economic and health burden of visual impairment. Global Public Health. 2012. p. 465–81.

46. Stevens GA, White RA, Flaxman SR, Price H, Jonas JB, Keeffe J, et al. Global prevalence of vision impairment and blindness: magnitude and temporal trends, 1990-2010. Ophthalmology. 2013 Dec;120(12):2377–84.

47. Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. Br J Ophthalmol. 2012 May;96(5):614–8.

48. Chiang PPC, Keeffe JE, Le Mesurier RT, Taylor HR. Global burden of disease and visual impairment. Lancet. 2006 Jul 29;368(9533):365.

49. International Agency for the Prevention of Blindness. State of the World Sight_2010.pdf [Internet]. 2010 [cited 2014 Nov 3]. Available from: http://www.iapb.org/sites/iapb.org/files/State of the World Sight_2010.pdf

50. Smith TST, Frick KD, Holden BA, Fricke TR, Naidoo KS. Potential lost productivity resulting from the global burden of uncorrected refractive error. Bull World Health Organ. 2009 Jun;87(6):431–7.

51. Frick KD, Foster A. The magnitude and cost of global blindness: an increasing problem that can be alleviated. Am J Ophthalmol. 2003 Apr;135(4):471–6.

52. World Health Organization (WHO). International Classification of Diseases (ICD) [Internet]. World Health Organization; [cited 2015 Feb 4]. Available from: http://www.who.int/classifications/icd/en/

53. Bourne RRA, Stevens GA, White RA, Smith JL, Flaxman SR, Price H, et al. Causes of vision loss worldwide, 1990-2010: a systematic analysis. lancet Glob Heal. 2013 Dec;1(6):e339–49.

54. Thylefors B, Négrel AD, Pararajasegaram R, Dadzie KY. Global data on blindness. Bull World Health Organ. 1995 Jan;73(1):115–21.

55. Myers CE, Klein BEK, Gangnon R, Sivakumaran TA, Iyengar SK, Klein R. Cigarette smoking and the natural history of age-related macular degeneration: the Beaver Dam Eye Study. Ophthalmology. 2014 Oct;121(10):1949–55.

56. Jonasson F, Fisher DE, Eiriksdottir G, Sigurdsson S, Klein R, Launer LJ, et al. Five-year incidence, progression, and risk factors for age-related macular degeneration: the age, gene/environment susceptibility study. Ophthalmology. 2014 Sep;121(9):1766–72.

57. Cundiff DK, Nigg CR. Diet and diabetic retinopathy: insights from the Diabetes Control and Complications Trial (DCCT). MedGenMed. 2005 Jan;7(1):3.

58. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. Bull World Health Organ. 2008 Jan;86(1):63–70.

59. Hollows F, Moran D. Cataract--the ultraviolet risk factor. Lancet. 1981 Dec 5;2(8258):1249–50.

60. Dolin PJ. Ultraviolet radiation and cataract: a review of the epidemiological evidence. Br J Ophthalmol. 1994 Jun;78(6):478–82.

61. Klein R, Lee KE, Gangnon RE, Klein BEK. The 25-year incidence of visual impairment in type 1 diabetes mellitus the wisconsin epidemiologic study of diabetic retinopathy. Ophthalmology. 2010 Jan;117(1):63–70.

62. Chang JR, Koo E, Agrón E, Hallak J, Clemons T, Azar D, et al. Risk factors associated with incident cataracts and cataract surgery in the Age-related Eye Disease Study (AREDS): AREDS report number 32. Ophthalmology. 2011 Nov;118(11):2113–9.

63. Gómez-Ulla F, Parra SO. Informe sobre la ceguera en España - EY - España [Internet]. 2012 [cited 2014 Nov 24]. Available from: http://www.ey.com/ES/es/Industries/Life-Sciences/Informe-sobre-la-ceguera-en-Espana--Intro

64. "Ministerio de Sanidad SS, e Igualdad". Sistema de información sobre listas de espera en el sistema nacional de salud. [Internet]. 2010 [cited 2014 Nov 26]. Available from: http://www.msssi.gob.es/estadEstudios/estadisticas/inforRecopilaciones/docs/ListaEsperaJunio10_CISNS.pdf

65. Anderson G, Black C, Dunn E, Alonso J, Christian-Norregard J, Folmer-Anderson T, et al. Willingness to pay to shorten waiting time for cataract surgery. Health Aff (Millwood). Jan;16(5):181–90.

66. Rius A, Guisasola L. Informe de la Salud Visual en Centroamérica 2004. Càtedra UNESCO Salud Visual y Desarrollo, editor. 2004.

67. Vision y Vida. Libro Blanco de la Visión en España 2009. 2009. 117–38 p.

68. Lafuma AJ, Brézin AP, Fagnani FL, Mesbah M, Berdeaux GH. Prevalence of visual impairment in relation to the number of ophthalmologists in a given area: a nationwide approach. Health Qual Life Outcomes. 2006 Jan;4:34.

69. Culham LE, Ryan B, Jackson AJ, Hill AR, Jones B, Miles C, et al. Low vision services for vision rehabilitation in the United Kingdom. Br J Ophthalmol. 2002 Jul;86(7):743–7.

70. Norregaard JC, Bernth-Petersen P, Alonso J, Dunn E, Black C, Andersen TF, et al. Variation in indications for cataract surgery in the United States, Denmark, Canada, and Spain: results from the International Cataract Surgery Outcomes Study. Br J Ophthalmol. 1998 Oct;82(10):1107–11.

71. Ulldemolins AR, Lansingh VC, Valencia LG, Carter MJ, Eckert K a. Social inequalities in blindness and visual impairment: a review of social determinants. Indian J Ophthalmol. 2011;60(5):368–75.

72. Allemani C, Storm H, Voogd AC, Holli K, Izarzugaza I, Torrella-Ramos A, et al. Variation in "standard care" for breast cancer across Europe: a EUROCARE-3 high resolution study. Eur J Cancer. 2010 Jun;46(9):1528–36.

73. Markopoulos C, van de Water W. Older patients with breast cancer: is there bias in the treatment they receive? Ther Adv Med Oncol. 2012 Nov;4(6):321–7.

74. Ryskulova A, Turczyn K, Makuc DM, Cotch MF, Klein RJ, Janiszewski R. Self-reported age-related eye diseases and visual impairment in the United States: results of the 2002 national health interview survey. Am J Public Health. 2008 Mar;98(3):454–61.

75. Varma R, Chung J, Foong AWP, Torres M, Choudhury F, Azen SP. Four-year incidence and progression of visual impairment in Latinos: the Los Angeles Latino Eye Study. Am J Ophthalmol. 2010 May;149(5):713–27.

76. Landers J, Henderson T, Craig J. The prevalence and causes of visual impairment in indigenous Australians within central Australia: the Central Australian Ocular Health Study. Br J Ophthalmol. 2010 Sep 1;94(9):1140–4.

77. Zhang X, Cotch MF, Ryskulova A, Primo SA, Nair P, Chou C-F, et al. Vision health disparities in the United States by race/ethnicity, education, and economic status: findings from two nationally representative surveys. Am J Ophthalmol. 2012 Dec;154(6 Suppl):S53–62.e1.

78. Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel GP, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004;82(11):844–51.

79. Cedrone C, Nucci C, Scuderi G, Ricci F, Cerulli A, Culasso F. Prevalence of blindness and low vision in an Italian population: a comparison with other European studies. Eye (Lond). 2006 Jun;20(6):661–7.

80. Jadoon MZ, Dineen B, Bourne RRA, Shah SP, Khan MA, Johnson GJ, et al. Prevalence of blindness and visual impairment in Pakistan: the Pakistan National Blindness and Visual Impairment Survey. Invest Ophthalmol Vis Sci. 2006 Nov;47(11):4749–55.

81. Rabiu MM, Gudlavalleti MVS, Gilbert CE, Sivasubramaniam S, Kyari F, Abubakar T. Ecological determinants of blindness in Nigeria: the Nigeria National Blindness and Visual Impairment Survey. S Afr Med J. 2011 Jan;101(1):53–8.

82. Dandona L, Dandona R, Srinivas M, Giridhar P, Vilas K, Prasad MN, et al. Blindness in the Indian state of Andhra Pradesh. Invest Ophthalmol Vis Sci. 2001 Apr;42(5):908–16.

83. Zhao J, Ellwein LB, Cui H, Ge J, Guan H, Lv J, et al. Prevalence of vision impairment in older adults in rural China: the China Nine-Province Survey. Ophthalmology. 2010 Mar;117(3):409–16, 416.e1.

84. Entekume G, Patel J, Sivasubramaniam S, Gilbert CE, Ezelum CC, Murthy GVS, et al. Prevalence, causes, and risk factors for functional low vision in Nigeria: results from the national survey of blindness and visual impairment. Invest Ophthalmol Vis Sci. 2011 Aug;52(9):6714–9.

85. Ho VH, Schwab IR. Social economic development in the prevention of global blindness. Br J Ophthalmol. 2001 Jun;85(6):653–7.

86. Yip JLY, Luben R, Hayat S, Khawaja AP, Broadway DC, Wareham N, et al. Area deprivation, individual socioeconomic status and low vision in the EPIC-Norfolk Eye Study. J Epidemiol Community Health. 2014 Mar;68(3):204–10.

87. Zheng Y, Lamoureux E, Finkelstein E, Wu R, Lavanya R, Chua D, et al. Independent impact of area-level socioeconomic measures on visual impairment. Invest Ophthalmol Vis Sci. 2011 Jan;52(12):8799–805.

88. Sit AJ, Chipman M, Trope GE. Blindness registrations and socioeconomic factors in Canada: an ecologic study. Ophthalmic Epidemiol. 2004 Jul;11(3):199–211.

89. Day F, Buchan JC, Cassells-Brown A, Fear J, Dixon R, Wood F. A glaucoma equity profile: correlating disease distribution with service provision and uptake in a population in Northern England, UK. Eye (Lond). 2010 Sep;24(9):1478–85.

90. Muñoz B, West S, Rodriguez J, Sanchez R, Broman A, Snyder R, et al. Blindness, visual impairment and the problem of uncorrected refractive error in a Mexican-American population: Proyecto VER. Investig Ophthalmol Vis Sci. 2002;43:608–14.

91. Rius A, Guisasola L, Sabidó M, Leasher JL, Moriña D, Villalobos A et al. Prevalence of visual impairment in El Salvador: inequalities in educational level and occupational status (approved). Rev Panam Salud Publica. 36(5):290–9.

92. Evans J, Fletcher A, Wormald R, Ng E, Stirling S, Smeeth L, et al. Prevalence of visual impairment in people aged 75 years and older in Britain: results from the MRC trial of assessment and management of older people in the community. Br J Ophthalmol. 2002 Jul;86(7):795–800.

93. The Eye Diseases Prevalence Research Group. Causes and Prevalence of Visual Impairment Among Adults in the United States. Arch Ophthalmol. 2004;122:477–85.

94. Rodriguez J, Sanchez R, Munoz B, West S, Broman A, Snyder R, et al. Causes of Blindness and Visual Impairment in a Population-based Sample of U.S. Hispanics. Ophthalmology. 2002 Apr;109(4):737–43.

95. Abou-Gareeb I, Lewallen S, Bassett K, Courtright P. Gender and blindness: a meta-analysis of population-based prevalence surveys. Ophthalmic Epidemiol. 2001;8:39–56.

96. Klein R, Lee KE, Gangnon RE, Klein BEK. Incidence of visual impairment over a 20-year period: the Beaver Dam Eye Study. Ophthalmology. 2013 Jun;120(6):1210–9.

97. Hennis AJ, Wu S-Y, Nemesure B, Hyman L, Schachat AP, Leske MC. Nine-year incidence of visual impairment in the Barbados Eye Studies. Ophthalmology. 2009 Aug;116(8):1461–8.

98. Dimitrov P, Mukesh B, McCarty C, Taylor H. Five-Year Incidence of Bilateral Cause-Specific Visual Impairment in the Melbourne Visual Impairment Project. Invest Ophthalmol Vis Sci. 2003 Dec;44(12):5075–81.

99. Jacobson L, Hård A, Horemuzova E, Hammarén H, HEllström A. Visual impairment is common in children born before 25 gestational weeks—boys are more vulnerable than girls. Acta Paediatr. 2009;98(2):261–5.

100. Blohmé J, Tornqvist K. Visual impairment in Swedish children. I. Register and prevalence data. Acta Ophthalmol Scand. 1997 Apr;75(2):194–8.

101. Lewallen S, Mousa A, Bassett K, Courtright P. Cataract surgical coverage remains lower in women. Br J Ophthalmol. 2009 Mar;93(3):295–8.

102. Arber S, McKinlay J, Adams A, Marceau L, Link C, O'Donnell A. Patient characteristics and inequalities in doctors' diagnostic and management strategies relating to CHD: A video-simulation experiment. Soc Sci Med. 2006;62:103–15.

103. Zhang X, Saaddine J, Lee PP, Grabowski D, Kanjilal S, Duenas M, et al. Eye care in the United States: do we deliver to high-risk people who can benefit most from it? Arch Ophthalmol. 2007;125:411–8.

104. Harris B, Sampson G. Gender differences in the utilisation of optometric services in Victoria. Cllinical Exp Optom. 2005;88(2):109–12.

105. Reasons for not seeking eye care among adults aged ≥40 years with moderate-to-severe visual impairment--21 States, 2006-2009. MMWR Morb Mortal Wkly Rep. 2011 May 20;60(19):610–3.

106. Salive ME, Guralnik J, Christen W, Glynn RJ, Colsher P, Ostfeld AM. Functional blindness and visual impairment in older adults from three communities. Ophthalmology. 1992 Dec;99(12):1840–7.

107. Bailey RN, Indian RW, Zhang X, Geiss LS, Duenas MR, Saaddine JB. Visual impairment and eye care among older adults - five States, 2005. MMWR Morb Mortal Wkly Rep. 2006 Dec 15;55(49):1321–5.

108. Guisasola L, Tresserras-Gaju R, García-Subirats I, Rius A, Brugulat-Guiteras P. [Prevalence and burden of visual impairment in Catalonia, Spain]. Med Clin (Barc). 2011;137 Suppl :22–6.

109. Centers for Disease Control and Prevention (CDC). Prevalence of visual impairment and selected eye diseases among persons aged >/=50 years with and

without diabetes--United States, 2002. MMWR Morb Mortal Wkly Rep. 2004 Nov 19;53(45):1069–71.

110. Klein R, Lee KE, Gangnon RE, Klein BEK. Relation of Smoking, Drinking, and Physical Activity to Changes in Vision over a 20-Year Period. Ophthalmology. 2014 Jun;121(6):1220–8.

111. Noertjojo K, Maberley D, Bassett K, Courtright P. Awareness of eye diseases and risk factors: identifying needs for health education and promotion in Canada. Can J Ophthalmol / J Can d'Ophtalmologie. 2006 Oct;41(5):617–23.

112. Sharma HE, Mathewson PA, Lane M, Shah P, Glover N, Palmer H, et al. The role of social deprivation in severe neovascular age-related macular degeneration. Br J Ophthalmol. 2014 Dec;98(12):1625–8.

113. Zhang X, Beckles GL, Chou C-F, Saaddine JB, Wilson MR, Lee PP, et al. Socioeconomic disparity in use of eye care services among US adults with age-related eye diseases: National Health Interview Survey, 2002 and 2008. JAMA Ophthalmol. 2013 Sep;131(9):1198–206.

114. Dickey H, Ikenwilo D, Norwood P, Watson V, Zangelidis A. Utilisation of eye-care services: the effect of Scotland's free eye examination policy. Health Policy. 2012 Dec;108(2-3):286–93.

115. Lee DJ, Arheart KL, Lam BL, Zheng D, Christ SL, McCollister KE, et al. Trends in reported visual impairment in United States adults. Ophthalmic Epidemiol. Jan;16(1):42–9.

116. Negrel AD, Minassian DC, Sayek F. Blindness and low vision in southeast Turkey. Ophthalmic Epidemiol. 1996 Dec;3(3):127–34.

117. Ayed S, Négrel AD, Nabli M, Kamel N, Jebri AM, Siddhom M. [Prevalence and causes of blindness in the Tunisian Republic. Results of a national survey conducted in 1993. Tunisian Team on the Evaluation of Blindness]. Sante. Jan;8(4):275–82.

118. Mansour AM, Kassak K, Chaya M, Hourani T, Sibai A, Alameddine MN. National survey of blindness and low vision in Lebanon. Br J Ophthalmol. 1997 Oct;81(10):905–6.

119. Organización Nacional de Ciegos de España. Datos estadísticos ONCE [Internet]. [cited 2015 Sep 8]. Available from: http://www.once.es/new/afiliacion/datos-estadisticos

120. Rees A, Bunce C, Patel P. Caution needed when examining certificate of vision impairment rates: the new public health indicator. Eye (Lond). 2013 Jul;27(7):892.

121. Esteban JJN, Martínez MS, Navalón PG, Serrano OP, Patiño JRC, Purón MEC, et al. Visual impairment and quality of life: gender differences in the elderly in Cuenca, Spain. Qual Life Res. 2008 Feb;17(1):37–45.

122. Hidalgo JL-T, Martínez IP, Bravo BN, Pretel FA, Ferrer AV, Verdejo MAL. Visual function versus visual acuity in older people. Ophthalmic Epidemiol. Jan;16(4):262–8.

123. Garin N, Olaya B, Lara E, Moneta MV, Miret M, Ayuso-Mateos JL, et al. Visual impairment and multimorbidity in a representative sample of the Spanish population. BMC Public Health. 2014 Jan;14:815.

124. Insituto Nacional de Estadística (INE). Survey on Disability, personal autonomy and dependency situations (AGE) 2007-2008. Methodology.

125. Laitinen A, Koskinen S, Härkänen T, Reunanen A, Laatikainen L, Aromaa A. A nationwide population-based survey on visual acuity, near vision, and self-reported visual function in the adult population in Finland. Ophthalmology. 2005 Dec;112(12):2227–37.

126. Klein BE, Klein R, Lee KE, Cruickshanks KJ. Associations of performance-based and self-reported measures of visual function. The Beaver Dam Eye Study. Ophthalmic Epidemiol. 1999 Mar;6(1):49–60.

127. Hiller R, Krueger DE. Validity of a survey question as a measure of visual acuity impairment. Am J Public Health. 1983 Jan;73(1):93–6.

128. UCLA - Institute for digital research and education. Regression with SPSS Chapter 5: Additional coding systems for categorical variables in regression analysis [Internet]. [cited 2015 Jul 19]. Available from: http://www.ats.ucla.edu/stat/spss/webbooks/reg/chapter5/spssreg5.htm

129. Consulta Interactiva del SNS [Internet]. [cited 2014 Nov 26]. Available from: http://pestadistico.msssi.es/publicoSNS/comun/DefaultPublico.aspx

130. Ruiz-Ramos M, Escolar-Pujolar A, Mayoral-Sánchez E, Corral-San Laureano F, Fernández-Fernández I. La diabetes mellitus en España: mortalidad, prevalencia, incidencia, costes económicos y desigualdades. Gac Sanit. Elsevier; 2006 Mar 1;20:15–24.

131. Espelt A, Kunst AE, Palència L, Gnavi R, Borrell C. Twenty years of socio-economic inequalities in type 2 diabetes mellitus prevalence in Spain, 1987-2006. Eur J Public Health. 2012 Dec;22(6):765–71.

132. Nucci C, Cedrone C, Culasso F, Ricci F, Cesareo M, Corsi A, et al. Incidence of visual loss in the Ponza Eye Study, Italy. Eye (Lond). 2005 Feb;19(2):175–82.

133. Klein BEK, Klein R, Lee KE, Gangnon RE. Incidence of age-related cataract over a 15-year interval the Beaver Dam Eye Study. Ophthalmology. 2008 Mar;115(3):477–82.

134. McCarty CA, Mukesh BN, Dimitrov PN, Taylor HR. Incidence and progression of cataract in the Melbourne Visual Impairment Project. Am J Ophthalmol. 2003 Jul;136(1):10–7.

135. Allin S, Grignon M, Le Grand J. Subjective unmet need and utilization of health care services in Canada: what are the equity implications? Soc Sci Med. 2010 Feb 1;70(3):465–72.

136. Rius A, Artazcoz L, Guisasola L, Benach J. Visual impairment and blindness in Spanish adults: Geographic inequalities are not explained by age or education. Ophthalmology. 2014;121(1):408–16.

137. Conjunto Mínimo Básico de Datos – Ambulatorio (CMBD AAE). [Internet]. [cited 2015 Jan 20]. Available from: http://pestadistico.inteligenciadegestion.msssi.es/publicoSNS/comun/ArbolNodos.aspx

138. Quintana JM, Garcia S, Aguirre U, Gonzalez N, Arteta E, Escobar A, et al. Relationship of sociodemographic variables with outcomes after cataract surgery. Eye (Lond). 2013 Jun;27(6):698–707; quiz 708.

139. Worley A, Grimmer-Somers K. Risk factors for glaucoma: what do they really mean? Aust J Prim Health. CSIRO PUBLISHING; 2011 Jan 5;17(3):233–9.

8 Annexes

8.1 Annex 1: Bibliographic review of inequalities in visual impairment and blindness

Ulldemolins AR1, Lansingh VC, Valencia LG, Carter MJ, Eckert KA. Social inequalities in blindness and visual impairment: a review of social determinants. *Indian J Ophthalmol*. 2012 Sep-Oct;60(5):368-75

Ulldemolins AR, Lansingh VC, Valencia LG, Carter MJ, Eckert KA. Social inequalities in blindness and visual impairment: a review of social determinants. Indian J Ophthalmol. 2012 Sep-Oct;60(5):368-75. doi: 10.4103/0301-4738.100529.

8.2 Annex 2: Introducing educational level and occupational status on the standardized methodology for the Rapid Assessment on Avoidable Blindness supported by the International Agency for the Prevention of Blindness

Rius A, Guisasola L, Sabidó M, Leasher JL, Moriña D, Villalobos A, Lansingh VC, Mujica OJ, Rivera-Handal JE, Silva JC. Prevalence of visual impairment in El Salvador: inequalities in educational level and occupational status. *Rev Panam Salud Publica*. 2014 Nov;36(5):290-9.

Rius A, Guisasola L, Sabidó M, Leasher JL, Moriña D, Villalobos A, Lansingh VC, Mujica OJ, Rivera-Handal JE, Silva JC. Prevalence of visual impairment in El Salvador: inequalities in educational level and occupational status. Rev Panam Salud Publica. 2014 Nov;36(5):290-9.