Laura Guisasola^a, Ricard Tresserras^b, Anna Rius^a, Elisabeth Purti^c. Visual correction and occupational social class. *Optom Vis Sci.* 2014; 91(4): 464-71

a) UNESCO Chair Visual Health and Development, Polytechnic University of Catalonia, Violinista Vellsolà 37. 08222 Terrassa, Barcelona

b) Department of Health, Autonomous Government of Catalonia. General Direction for Health Planning and Research. Travessera de les Corts 131/159, 08028 Barcelona

c) Directorate of Health, Asepeyo Prevention Society. Via Augusta 18,2^ap, 08002 Barcelona

3 tables and 4 figures

Corresponding author:

Laura Guisasola.

UNESCO Chair Visual Health and Development.

Polytechnic University of Catalonia

Violinista Vellsolà 37. Terrassa 08222.

Barcelona. Spain.

e-mail: guisasola@oo.upc.edu

Phone: +34937398913, +34 607923601

Fax: +34937398300

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Abstract

Purpose: To determine whether types of optical correction for refractive error are associated with gender, social class and occupational group in the working population.

Methods: A cross-sectional study was carried out among employees in Catalonia (Spain) aged 16 to 65 years who underwent the Asepeyo Prevention Society health examination in 2009 (86,831 participants, 59,397 men, 27,421 women). The type and purpose of refractive correction used was self-reported, as were socio-demographic variables; VA with habitual correction was also measured. We performed descriptive and logistic regression analyses to evaluate the prevalence and type of correction used for refractive error as a function of age, gender, social class and occupational group.

Results: 46% (95%CI=45.6-46.3) of individuals in this sample were users of optical correction for refractive error. Use of optical correction was more common among women than men (54.8% and 41.9%, respectively), and especially among women aged 55-64 years (91.8%). Non-manual (class I) workers were three times more likely to use optical correction than manual (class V) workers (OR=3.02; 95%CI=2.82-3.24). Individuals in technical, administrative or intellectual occupations were more likely to wear optical correction than unskilled professionals.

Conclusions: The use of visual correction is more prevalent among women than men, especially in older individuals. The use of optical correction is more common among more advantaged social groups, and is associated with particular occupations.

Keywords: cross-sectional studies; employees; glasses, occupation, social class

1 Introduction

2 Uncorrected refractive error is the principal cause of visual impairment and
3 blindness worldwide¹, as recognized by the WHO². Refractive error correction is
4 one of the most simple and effective health interventions, and is essential in the
5 working environment for productivity³, employee welfare, and reduction of
6 occupational risk⁴.

7 People with severe visual impairment have reduced occupational
8 competitiveness, and poorer chances of immersion in the labor market. Their
9 opportunities to develop new skills⁵ are also more limited, their productivity and
10 welfare are reduced, and their risk of accidents increases.

11 In a previous study of vision problems in the working population of Catalonia⁶,
12 we evaluated problems that cause visual acuity below 0.5 (visual impairment),
13 as well as those that do not cause any visual impairment, and concluded that
14 visual impairment was more common in manual and disadvantaged social
15 classes^{7,8,9}, whereas vision problems without impairment were more common in
16 non-manual and advantaged social classes^{4,7,10}. These problems were mainly
17 due to refractive errors that were fully or partly resolved by optical correction.
18 This finding prompted us to extend this study to the use of correction and its
19 relationship with social class and occupational group. Given that social class
20 assignment is based on workers' occupation, these two labor-specific variables,
21 justify this study's focus on the working population, we note that it would also be
22 of great interest to perform a similar analysis in the general population.

23 Four previous studies have analyzed the association between optical correction
24 for refractive error and social class or occupation in high-income countries (two
25 in Finland^{11,12}, one on the use of contact lenses in the US¹³, and a multicenter
26 study of five European countries¹⁴), and two Asian studies^{15,16} analyzed the
27 association between optical correction and social class in middle-income
28 countries. None of these studies was carried out in the working population, and
29 there is no previous evidence on how the use of different types of refractive
30 error correction may vary as a function of social class and occupation.

31 The Spanish public health system provides universal access to healthcare, but
32 does not cover refractive error correction using either glasses or contact lenses.
33 Thus, optical correction is a private payment service whose cost is a function of
34 the power of the lenses required and the selected frame. This has economic
35 implications¹⁷ that could partially explain differences in access between social
36 classes and occupational groups.

37 This study addresses the social and health problems of poor vision in the
38 workplace as a result of inequalities in the use and type of correction between
39 social classes and occupation

40

41 The aim of the study is to analyze the magnitude and distribution of the use of
42 optical correction for refractive error in a sample of the working population of
43 Catalonia, Spain, and to determining whether there are differences between
44 gender, social classes and occupational groups.

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Materials and Methods:

Study Population

The study sample consisted of Catalonia-based employees of companies covered by Asepeyo Prevention Society (SPdA) who underwent a health examination in 2009. According to SPdA, 60% of workers in each company attended the exam, on average.

The sample consists of 86,831 workers (59,397 men and 27,421 women) aged between 16 and 65 years. Of these, 1,363 workers (1.55%) who were habitual wearers of optical correction were excluded because they had not brought their glasses or contact lenses with them on the day of the vision study, resulting in a final study sample size of 85,468. (see discussion).

Data Collection

Prevention Corporations are entities whose function is to provide external prevention services to companies. Workers undergo a comprehensive health examination depending on the specific occupational hazards, including a sight examination.

Workers were referred to the delegation of SPdA that was situated closest to their workplace, and the visit was structured in two phases.

In the first phase, the examiner subjected the patient to a questionnaire on personal and family history of eye disease, history of ocular surgery and ocular drugs use, and determined which types of vision tests should be performed.

In the second phase, participants were asked if they use glasses or contact lenses (Fig. 1), and if so, self-reported information on the type (single vision, bifocal, progressive addition lenses, or contact lenses) and main purpose of the correction (distance, near, or all-purpose) was recorded. If a patient reported that they regularly wore two different pairs of glasses, both were analyzed. Although the examiner verified the type of correction, the power of the lenses was not measured. The visual acuity measurements were made for all participants. Presenting monocular and binocular near and distance visual acuity was determined using the Screenoscope instrument (Control Vision Screenoscope Topcon SS-3, Tokyo Japan), a stereoscopic instrument designed to examine visual functions such as visual acuity, astigmatism, phorias and stereopsis. Thanks to its simplicity and speed, this instrument is suitable for use in hospitals, clinical examinations, schools, driving tests factories, and companies' premises. No objective or subjective refraction exam was carried

out in any of the participants, and best corrected visual acuity was not determined.

Variables

The dependent variables were i) the use of correction, defined as individuals who wore glasses or contact lenses at the time of the health examination, and ii) type of correction, which was categorized into five groups, single far vision, single near vision, bifocal, progressive addition lenses (PAL), and contact lenses (CL).

The independent variables were:

- Age, categorized into 5 groups 16-24, 25-34, 35-44, 45-54 and 55-64 years
- Social class¹⁸, categorized into 6 groups (I-III defined non-manual, and IV-V as manual):
 - I. Executives of public companies with >10 employees. Professions associated with second and third cycle of university
 - II. Managers of firms with fewer than 10 employees. Professionals with a college degree. Technicians, artists and athletes.
 - III. Administrative employees and professionals involved in support of administrative and financial management; Personal service and security workers; Self-employed; Supervisors of manual workers.
 - IVa. Skilled manual workers.
 - IVb. Semi-skilled manual workers
 - V Unskilled
- Occupational group, structured in ten categories¹⁹:
 - 1. Military
 - 2. Business and public administration managers
 - 3. Technical, scientific and intellectual professionals
 - 4. Technicians and support professionals
 - 5. Administrative employees
 - 6. Restaurant services, personal protection and sellers of businesses
 - 7. Skilled workers in agriculture and fishing
 - 8. Artisans and skilled workers in manufacturing, construction and mining.
 - 9. Plant and machinery operators and assemblers
 - 10. Unskilled

Analysis

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121 Bivariate analysis was performed using chi-square tests to test for association
122 between correction magnitudes and types and each of the independent
123 variables: age, social class and occupational group. Age-adjusted logistic
124 regression models were fit, and odds ratios (ORs) and 95% confidence intervals
125 (CIs) were calculated to assess the relationship between the use of correction
126 and age, social class and occupational group. All analyses were stratified by
127 sex, and were carried out using SPSS v17.0

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Results

Types of visual correction

46% (95% CI= 45.6-46.3) of workers (39,275) were habitual wearers of optical correction due to refractive error. Use of correction was more common among women (54.8%, n=14,833) than men (41.9%, n=24,442). 55.3% (21,735) of users were corrected for distance vision, (21%, n=8,253) for near vision, and (23.6%, n=9,287) for both. Almost half of the corrections (48.2%, n=18,935) were single vision lenses for distance vision, followed by PAL (22.7%, n=8,935) and single vision lenses for near vision (21%, n=8,253; Table 1).

Prevalence of type of visual correction according to sex, age and social class

In the 55-64 years age group, 84.8% of men and 91.8% of women used visual correction. Notably, most of these individuals had had their presbyopia corrected using progressive addition lenses (men, 45.3%; women, 49.7%) or single near vision lenses (men, 25.9%; women, 26.1%).

Only 19.3% of young male workers aged 16-24 years used visual correction, mainly single distance vision (72.5%) or contact lenses (25.3%), compared to 39.9% of females.

58.4% of men in social class I used correction, compared to just 30.3% in social class V; the differences between classes were smaller in women (59.8% and 48.7%, respectively). The prevalence of use of progressive lenses in men from class I (14.9%) was twice that in men from class V (7.1%), and remained higher in non-manual compared to manual groups. However the prevalence of use of progressive lenses among women was more evenly distributed between social classes. We observed a higher prevalence of contact lens use in non-manual groups, especially among women (between 7.1% and 10% in classes I, II and III). We observed no differences in the use of near vision spectacles between social classes in either sex. Bifocals were used infrequently, with prevalence between 0.3% and 0.6% in all classes and among both men and women. (Table 2)

The use of optical correction was significantly more common among non-manual social classes and in women of all groups (Figure 2).

Association between visual correction and sex, occupational group and social class

We fit age-adjusted logistic regression models, taking unskilled workers as reference group. Four occupational groups were found to be more likely to wear optical correction: administrative employees (OR=3.15; 95%CI=2.9-3.42) followed by technical, scientific and intellectual professionals (OR=2.99; 95%CI=2.81-3.18), technicians and support professionals (OR=2.71; 95%CI=2.58-2.85) and business and public administration managers (OR=2.5; 95%CI=2.28-2.75). Stratifying this analysis by gender, a similar pattern was

174 observed for these occupational groups, but with slightly greater differences
175 among men (OR range from 2.74 to 3.49) compared to women (OR range from
176 2.15 to 2.28) (Table 3).

177 In terms of social class, the likelihood of wearing correction was higher in non-
178 manual classes (OR=3.02, 95%CI=2.82-3.24, in class I compared to class V),
179 and again this difference was more exaggerated among men (OR=3.41;
180 95%CI=3.13- 3.72) than among women (OR=2.46; 95% CI= 2.19-2.76).

181 *Visual acuity according social class and occupational group*

182 We observed generally higher visual acuity among non-manual compared to
183 manual social classes, with similar distributions for both near and distance
184 visual acuity measured with habitual correction (Fig 3). Consistent with this, we
185 also observed generally higher distance visual acuity among individuals in the
186 four occupational groups mentioned above (administrative employees,
187 technical, scientific and intellectual professionals, business and public
188 administration managers, and technicians and support professionals; Fig 4).

Discussion

In this study, which focuses on the use rather than the need for visual correction, we highlight three main findings: 1) half of the workers in the study were habitual wearers of optical correction for refractive error; 2) there were notable differences between social classes and occupational groups in the use and type of optical correction and in visual acuity; and 3) the proportion of correction use was consistently higher among women than men²⁰, especially among manual workers.

Age is a key factor in the use of correction due to the onset of presbyopia and the resulting need for near distance correction²¹. However, the differences we observed between social classes and occupational groups remained even after adjusting for age.

Our study showed that the most common type of correction was single vision lenses (48.2%), followed by progressive addition lenses (22.7%), which is consistent with the results reported by Lafuma *et al.*¹⁴ (single vision, 52.2%; PAL, 24.1%).

Our study shows that a higher proportion women (54.8%) use optical correction than men (41.9%), which is consistent with the results of Lafuma *et al.*¹⁴ in a study conducted in five European countries, including Spain (women, 53.5%; men, 46.5%), and those of Pärssinen *et al.*²² in a study carried out in Finland. Similarly, The Eye Diseases Prevalence Research Group²³ found that that hyperopia, but not myopia, is more common among women. An important factor to consider is the fact that women generally are more aware of their health problems and more proactive in seeking solutions. This is reflected in our previous work on the burden of visual defects in Catalonia²⁴, which highlighted the fact that women are more likely to use eye medication and to visit eye specialists, a similar observation to that reported by Stang and Jöckel in a German study⁹. A meta-analysis²⁵ of sex-specific differences in presbyopia showed that females were more likely than males to need near vision correction, after controlling for age. However, gender differences were not due to differences in focusing ability, but rather to gender differences in factors related to preferred reading distances, such as arm length, occupation, indoor light levels, and specific conditions related to desired tasks.

Economic factors have been identified as the main barrier to accessing eye care services and the acquisition of glasses^{7,26,27}. In a study carried out in Los Angeles²⁸, over 50% of people who had been prescribed corrective glasses had not acquired them, mainly for economic reasons. Other aspects not explored in this study, such as discomfort or cultural acceptance of the use of glasses may also be relevant. While these issues have been widely studied in students²⁹ or

people with visual impairment³⁰, it would be necessary to conduct qualitative studies in the adult population.

Our analysis highlights four occupational groups that are most likely to wear correction: business and public administration managers; technical, scientific and intellectuals professionals; technicians and support professionals, and administrative employees. Studies by Pärssinen *et al.*^{11,12} in Finland have shown a correlation between the use of glasses and occupations that require good vision for detailed near distance work, and those involving computer monitors. As in our study, these authors concluded that farmers, industry workers and service personnel were the occupational groups least likely to use correction, which is consistent with the fact that some tasks, such as those involving computer terminals have greater vision requirements than others³¹. Also, visual acuity is generally higher in these four occupational groups than in others.

Studies in Bangladesh¹⁵ and India¹⁶ have also reported that the highest prevalence of correction use is found among non-manual workers and those of higher socioeconomic status, and therefore, visual acuity is again generally higher in non-manual social classes.

In agreement with the results of a study conducted in the USA¹³, the use of contact lenses was most common in women, younger individuals and advantaged social classes, probably because their daily care requires a complex manipulation and use of expensive solutions³².

Data on visual acuity with habitual correction show that 2 out of every 100 individuals in the active working population studied had visual impairment ($VA < 0.5$) 2.2% (95%CI 2.1-2.3) even while wearing corrective lenses. Although this is a relatively low proportion, this group should receive special attention given that it represents the working population.

Our study has various limitations. Data were collected for presenting VA (with habitual correction), but not for VA without correction (i.e. without glasses for subjects who normally wear them), or for optimally corrected VA. In addition, the pin-hole test³³ was not used to identify uncorrected or under-corrected refractive errors.

Among individuals who were excluded from the study, 76% were male and 82.7% had been corrected for near vision. This may result in a slight underestimation of the prevalence of near vision corrections, especially among men.

As far as we are aware, ours is the first study of optical correction of refractive error in such a large population of workers from a high-income country. Our

exceptionally large sample size allows us to overcome some of the problems associated with stratifying by sex, age group, correction type, and social class.

Conclusions

The prevalence of correction use responds not only to the prevalence of refractive error, but also to other factors, such as the vision requirements inherent to certain occupations, purchasing power, and ability to identify the need for corrective lenses.

In this study of visual correction in a developed country with an aging population, almost half of individuals required vision correction, due in large part to the onset of presbyopia.

Since this is a study of the working population, our results cannot be generalized to the rest of the population; furthermore, the study analyzes the use of correction, and consequently underestimates the need for correction

This study shows a clear link between the use of optical correction and social class and occupational group. The prevalence of the use of correction is higher in more advantaged social groups, and is clearly associated with particular occupations.

Finally, the use of correction is more prevalent among women than among men.

None of the authors have any proprietary interests or conflicts of interests related to this submission

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Figure Legends

Figure 1. Study question sequence

Figure 2. Prevalence of visual correction, stratified by gender and social class

Figure 3. Distribution of distance visual acuity, stratified by social class

Figure 4 Distribution of distance visual acuity, stratified by occupational group

TABLES

Table 1.- Description of types of correction by sex and distance

Correction Type	All	Men	Women	Distance	Distance and near	Near
	n (%)	n (%)	n (%)	n(%)	n(%)	n (%)
Far single vision	18935 (48.2)	11542 (47.2)	7393 (49.8)	18935 (48.2)	-	-
Near single vision	8253 (21.0)	5316 (21.7)	2937 (19.8)	-	-	8253 (21.0)
Bifocals	352 (0.9)	271 (1.1)	81 (0.5)	-	352 (0.9)	-
PAL	8935 (22.7)	6156 (25.2)	2779 (18.7)	-	8935 (22.7)	-
CL	2800 (7.1)	1157 (4.7)	1643 (11.1)	2800 (7.1)	-	-
All	39275 (46.0)	24442 (41.9)	14833 (54.8)	21735 (55.3)	9287 (23.6)	8253 (21.0)

PAL: Progressive Addition lenses

CL: Contact Lenses

Table 2.- Prevalence of type of correction, according to sex, age and social class

	All	No correction	Any correction	Single far	Single near	Bifocal	PAL	CL	
Men									
age	n(%)	n(%)	n (%)	n (%)	n(%)	n(%)	n (%)	n(%)	P <.001
16-24	3791 (100)	3059 (80.7)	732 (19.3)	534 (14.1)	14 (0.4)	1 (0)	5 (0.1)	178 (4.7)	
25-34	16268 (100)	12139 (74.6)	4129 (25.4)	3473 (20.8)	108 (0.6)	1 (0)	26 (0.2)	521 (3.1)	
35-44	18223 (100)	12759 (70.0)	5464 (30.0)	4469 (24.2)	456 (2.5)	9 (0)	208 (1.1)	322 (1.7)	
45-54	13397 (100)	5013 (37.4)	8384 (62.7)	2306 (17.2)	3009 (22.5)	102 (0.8)	2851 (21.3)	116 (0.9)	
55-64	6485 (100)	985 (15.2)	5500 (84.8)	719 (11.1)	1678 (25.9)	145 (2.2)	2938 (45.3)	20 (0.3)	
missings	233 (0.4)	-	233 (0.4)	41 (0.1)	51 (0.1)	13 (0.0)	128 (0.2)	0 (0.0)	
Social Class									P <.001
I	4074 (100)	1691 (41.5)	2383(58.4)	1228 (30.1)	403 (9.9)	13 (0.3)	609 (14.9)	130 (3.2)	
II	4866 (100)	2643 (54.3)	2223 (45.6)	1252 (25.7)	377 (7.7)	20 (0.4)	439 (9)	135 (2.8)	
III	11069 (100)	5012 (45.3)	6057(54.7)	2885 (26.1)	1217 (11.0)	38 (0.3)	1613 (14.6)	304 (2.7)	
IVa	21663 (100)	13981 (64.5)	7682 (35.5)	3230 (14.9)	1989 (9.2)	124 (0.6)	2038 (9.4)	301 (1.4)	
IVb	6367 (100)	4084 (64.1)	2283 (35.8)	1117 (17.5)	536 (8.4)	26 (0.4)	516 (8.1)	88 (1.4)	
V	8262 (100)	5769 (69.8)	2493(30.3)	1172 (14.2)	576 (7.0)	40 (0.5)	585 (7.1)	120 (1.5)	
missings	2096 (100)	775 (1.3)	1321 (2.3)	658 (1.1)	218 (0.4)	10 (0.0)	356 (0.6)	79 (0.1)	
All	58397 (100)	33955 (58.7)	24442 (41.9)	11542 (19.5)	5316 (9.0)	271 (0.5)	6156 (10.4)	1157 (2.0)	
Women									
age									P <.001
16-24	1562 (100)	939 (60.1)	623 (39.9)	430 (27.5)	34 (2.2)	0 (0.0)	2 (0.1)	157 (10.1)	
25-34	8907 (100)	5053 (56.7)	3854 (43.3)	2898 (32.5)	202 (2.3)	5 (0.1)	12 (0.1)	737 (8.3)	
35-44	8531 (100)	4743 (55.6)	3788 (44.4)	2648(30.2)	486 (5.5)	3 (0.0)	122 (1.4)	529 (6.0)	
45-54	5984 (100)	1338 (22.4)	4646 (77.6)	1147(19.2)	1672 (27.9)	35 (0.6)	1603 (26.8)	189 (3.2)	
55-64	2021 (100)	165 (8.2)	1856 (91.8)	261 (12.9)	528 (26.1)	36 (1.8)	1004 (49.7)	27 (1.3)	
missing	66 (0.2)	-	66 (0.2)	9 (0.0)	15 (0.1)	2 (0.0)	36 (0.1)	4 (0.0)	
Social Class									P <.001
I	2184 (100)	876 (40.1)	1308 (59.8)	728 (33.3)	199 (9.1)	3 (0.1)	159 (7.3)	219 (10)	
II	3170 (100)	1408 (44.4)	1762 (55.6)	897 (28.3)	313(9.9)	7 (0.2)	317 (10.0)	228 (7.2)	
III	11793 (100)	4916 (41.7)	6877 (58.3)	3664(31.1)	1194 (10.1)	19 (0.2)	1160 (9.8)	840 (7.1)	
IVa	2184 (100)	1221 (55.9)	963 (44.2)	456 (20.9)	199(9.1)	4 (0.2)	222 (10.2)	82 (3.8)	
IVb	3031 (100)	1590 (52.5)	1441 (47.5)	631 (20.8)	354(11.7)	16 (0.5)	339 (11.2)	101 (3.3)	
V	4158 (100)	2131 (51.3)	2027 (48.7)	786 (18.9)	592 (14.2)	29 (0.7)	510 (12.3)	110 (2.6)	
missings	551 (4.7)	96 (3.0)	455 (1.7)	231 (0.9)	86 (0.3)	3 (0.0)	72 (0.2)	63 (0.2)	
All	27071 (100)	12238 (45.7)	14833 (54.8)	7393 (27.1)	2937 (10.7)	81(0.3)	2779 (10.2)	1643 (6)	

PAL: Progressive Addition lenses; CL: Contact Lenses
Classes I-III defined non-manual, and IV-V as manual

Table 3.- Association between visual correction and sex, occupational group and social class.

	Men aOR (95% CI)	Women aOR (95% CI)	All aOR (95% CI)
Occupational group			
Military	1.25 (0.82-1.89)	0.71 (0.35-1.45)	1.00 (0.7-1.43)
Business and public administration managers	2.85 (2.55-3.18)	2.28 (1.87-2.77)	2.5 (2.28-2.75)
Technical, scientific and intellectual professionals	3.49 (3.22-3.78)	2.15 (1.95-2.37)	2.99 (2.81-3.18)
Technicians and support professionals	2.74 (2.56-2.93)	2.14 (1.97-2.32)	2.71 (2.58-2.85)
Administrative employees	3.36 (2.95-3.82)	2.2 (1.97-2.47)	3.15 (2.9-3.42)
Restaurant services, personal protection, sellers	1.72 (1.53-1.93)	1.12 (1-1.26)	1.58 (1.46-1.71)
Skilled workers in agriculture and fishing	1.2 (1.01-1.42)	1.21 (0.8-1.82)	1.02 (0.87-1.2)
Artisans, skilled workers in manufacturing, construct, mining	1.09 (1.03-1.17)	0.82 (0.7-0.96)	0.88 (0.83-0.93)
Plant and machinery operators and assemblers	1.28 (1.19-1.37)	1.1 (0.97-1.25)	1.09 (1.03-1.15)
Unskilled	1	1	1
Social Class			
I	3.41 (3.13 – 3.72)	2.46 (2.19 – 2.76)	3.02 (2.82 – 3.24)
II	2.38 (2.20 – 2.58)	1.90 (1.72 – 2.11)	2.23 (2.09 – 2.37)
III	2.73 (2.56 – 2.93)	2.13 (1.97 – 2.31)	2.70 (2.57 – 2.84)
IVa	1.19 (1.12 – 1.26)	1.06 (0.94 – 1.19)	0.97 (0.92 – 1.02)
IVb	1.28 (1.19 – 1.39)	1.13 (1.02 – 1.26)	1.21 (1.14 – 1.29)
V	1	1	1

aOR: age adjusted Odds Ratio

Classes I-III defined non-manual, and IV-V as manual

Fig 1.

Fig 2.

Fig 3.

Fig 4.