The association between physical activity and cataracts among 17,777 people aged 15-69 years residing in Spain

Running title: Physical activity and cataracts in Spain

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Abstract:

Purpose: The aim of the present study was to assess the association between levels of physical activity (PA) and presence of cataracts in people aged 15-69 years residing in Spain. **Methods:** Cross-sectional data from the Spanish National Health Survey 2017 were analysed (n = 17,777 ≥15 years; 52% females; self-weighting sample). The International Physical Activity Questionnaire (IPAQ) short form was used to measure PA. Total PA MET-minutes/week were calculated, and participants were divided into two categories: 1) Less than 600 MET-minutes/week. 2) At least 600 MET-minutes/week, equivalent to meeting current PA recommendations. Cataracts were self-reported in response to the question ‘‘Have you ever been diagnosed with cataracts?”. Multivariable logistic regression was used to assess associations overall and by age groups (15–49, 50–64 and 65-69 years; 15-49 and 50-69 years). Covariates included in the analysis were: sex, education, BMI (Body Mass Index), multimorbidity, smoking, and alcohol consumption. **Results:** The overall prevalence of cataract was 3.7%, and the overall prevalence of participating in less than 600 MET-minutes/week of PA was 30.2%. In the adjusted overall analysis, less than 600 MET-minutes/week of PA was associated with significantly higher odds for cataract: OR = 1.324 (95% CI = 1.116–1.571). Age-stratified analyses showed that the association between PA and cataract was significant only in the age groups of 65-69 years and 50-69 years. **Conclusions:** A significant association between PA and cataract was observed in people aged 15-69 years residing in Spain. Considering the impact on health and quality of life due to reduced PA in people with cataract, at least 600 MET-minutes/week activity should be promoted.

Keywords: diabetic eye disease; cataract; physical activity; observational study.

INTRODUCTION

Cataracts are the leading cause of blindness, with an estimated 95 million people worldwide being affected[1]. There are different types of cataract including age-related cataract, paediatric cataract, and cataract secondary to other causes[1]. The most common type is age-related cataract, which can be further classified into various subtypes including nuclear, cortical, and posterior subcapsular (described in detail in Sihota and Tandon[2]). Although the aetiology of the condition is multi-faceted, several factors have been consistently associated with higher risk of cataract, including increasing age[1], sex (women have been shown to be at higher risk than men)[3,4], higher lifetime ultra-violet exposure[5], systemic diseases such as hypertension[6,7] and diabetes[7,8]. Also, lower levels of education have been associated with higher risk of cataract[3,9].

A small body of literature provides preliminary evidence that physical activity (PA) levels are associated with cataract risk. A recent population-based prospective cohort study suggested that people residing in Sweden with higher levels of PA had a 24% reduced risk of cataract compared with inactive populations[10]. Similarly, another prospective study of 9113 diabetic working-aged adults residing in Australia found that more vigorous PA was independently associated with a reduced risk of cataract surgery[11]. In a prospective cohort study conducted also in Australia, it was found that first and second eye cataract surgery each independently increased participation in moderate intensity leisure-time PA[12].

There are several mechanisms that are likely driving the association between PA levels and cataracts. Elevated C-reactive protein concentration has been shown to be associated with cataract risk and higher levels of PA are associated with lower levels of C-reactive proteins[10]. Higher levels of PA have also been shown to be associated with improved insulin resistance and decreased risk of diabetes and hypertension, which are

risk factors for cataracts[10]. In addition, cataracts can result in visual impairment which is associated with lower levels of PA[13,14]. Therefore, the association between PA and cataracts is likely bidirectional.

Considering the loss of vision associated with cataracts and the associated decrease in functional capacity and decreased quality of life, as well as potential modifiable lifestyle related risk factors, population-based epidemiological studies exploring these links are needed. Specifically, in previously unreported countries where the social and political context and lifestyle behaviours, likely influencing eye health, are different.

To the best of our knowledge there are no representative population-based studies exploring the association between PA and cataracts in Spain. It is therefore the aim of this study to assess associations between levels of PA and cataract prevalence in a Spanish population. Our hypothesis was that a lower level of PA would be significantly associated with a higher prevalence of cataracts.

MATERIALS AND METHODS

2.1. The survey

Data from the Spanish National Health Survey 2017 were analyzed. This survey was undertaken in Spain between October 2016 and October 2017. Details of the survey method have been already published[15]. In brief, for the data collection, a stratified three-stage sampling was used in which the census sections were first considered, then the family dwellings, and then an adult (15 years or more) was selected within each dwelling. The sections were selected within each stratum with probability proportional to their size. The dwellings, in each section, were selected with equal probability by systematic sampling, prior arrangement by size of the dwelling. This procedure leads to

self-weighting samples in each stratum. For the selection of the person who had to complete the Adult Questionnaire, the random Kish method was used, which assigns equal probability to all adults in the household. The sample was representative of the adult population resident in Spain, and consisted of 17,777 people aged 15-69 years. The age group of people ≥70 years was not considered in this study, as they did not complete the IPAQ short form; IPAQ short form is an instrument designed primarily for population surveillance of PA among adults, and it has been developed and tested for use in adults (age range of 15-69 years), and until further development and testing is undertaken the use of IPAQ with older and younger age groups is not recommended[16]. The method of data collection used was computer-assisted personal interviewing (CAPI), conducted in the homes of the selected participants. The interviewers, previously trained, completed the questionnaires with the information provided by the participants. All of them signed an informed consent form before responding to the survey questions.

2.2. Cataract (Outcome)

Those who answered affirmatively to the question ‘‘Have you ever been diagnosed with cataracts?” were considered to have cataracts.

2.3. Physical activity (Exposure)

IPAQ short form was used to measure PA. The unit of PA used was MET-minutes/week, where MET is the Metabolic Equivalent of Task (https://en.wikipedia.org/wiki/Metabolic_equivalent_of_task). Total PA MET-minutes/week were calculated through the following formula: *sum of Walking + Moderate + Vigorous MET-minutes/week scores*[16]. Participants were divided in two categories according to the guidelines for data processing and analysis of the IPAQ[16]: 1)

fewer than 600 MET-minutes/week and 2) at least 600 MET-minutes/week, equivalent to meeting current physical activity recommendations. IPAQ has been validated in adult populations from different countries showing acceptable validity (ρ=0.30, 95% CI: 0.23-0.36) and reliability (Spearman's ρ=0.81, 95% CI: 0.79-0.82)[17].

2.4. Co-variates

The selection of the control variables was based on past literature[1,18,19]. Sociodemographic variables included age, sex, and education. Education was based on the highest educational level achieved and was categorized as ≤ primary, secondary, and ≥ tertiary. Height and weight were self-reported. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Obesity was defined as BMI ≥ 30 kg/m^2. Multimorbidity was defined as the presence of two or more chronic conditions (excluding cataract). Those who answered affirmatively to the question ''Have you ever been diagnosed with 'chronic condition'?" were considered to have the specific chronic condition. Chronic conditions included obesity, hypertension, myocardial infarction, angina pectoris and other coronary diseases, other cardiac diseases, varicose veins of lower extremities, osteoarthritis, chronic neck pain, chronic low back pain, chronic allergy (excluding allergic asthma), asthma (including allergic asthma), chronic bronchitis, emphysema or chronic obstructive pulmonary disease (COPD), diabetes, peptic ulcer disease, urinary incontinence, hypercholesterolemia, chronic skin disease, chronic constipation, liver cirrhosis and other hepatic disorders, depression, anxiety disorder, other psychiatric disorders, stroke, chronic migraine and other frequent chronic headaches, hemorrhoids, cancer, osteoporosis, thyroid disease, renal disease, and injury. Smoking status was self-reported and categorized as never, current smoker, and former smoker. Alcohol consumption in the last 12 months was self-reported and categorized as: 1) Daily or almost daily. 2) 5-6 days per week. 3) 3-4

days per week. 4) 1-2 days per week. 5) 2-3 days in a month. 6) Once a month. 7) Less than once a month. 8) Not in the last 12 months, I have stopped drinking alcohol. 9) Never or just a few sips to try it throughout life.

2.5. Statistical analysis

The statistical analysis was performed with SPSS 23.0. Using Chi-squared tests, differences in the proportion of the study sample with sample characteristics were assessed after stratifying by cataract status. We conducted multivariable logistic regression analysis to assess the association between PA (exposure) and cataract (outcome). Analyses were conducted for the overall sample, and separately by age groups (15–49, 50–64 and 65-69 years; 15–49 and 50-69 years). All analyses were adjusted for sex, education, BMI, multimorbidity, smoking, and alcohol consumption; and the whole-sample analysis was also adjusted for age. All variables were included in the models as categorical variables with the exceptions of age and BMI, which were included as continuous variables. There were missing data only on the following variables: obesity (2.83%), smoking (0.06%), alcohol consumption (0.08%). Complete-case analysis was carried out (only participants for which we had no missing data were included in the analyses, while participants with any missing data were excluded). Results from the logistic regression analyses are presented as odds ratios (ORs) with 95% confidence intervals (CIs). The level of statistical significance was set at $P < 0.05$.

RESULTS

The sample consisted of 17,777 people aged 15-69 years residing in Spain. The age range of the sample was 15-69 years, and the mean (SD) age was 45.8 (14.1) years. 52% were female and 48% male. In this self-weighting sample, the overall prevalence of

cataract was 3.7%, and the overall prevalence of people doing less than 600 MET-minutes/week of PA was 30.2%. Overall, the prevalence of cataract among those doing less and more than 600 MET-minutes/week of PA was 4.7% and 3.3%, respectively. An increase in the prevalence of cataract was observed among those doing fewer and more than 600 MET-minutes/week of PA with increasing age, with a higher prevalence of cataract in those doing less than 600 MET-minutes/week in all age groups (Figure 1). Based on unadjusted estimates, advanced age, female sex, lower education, multimorbidity, obesity, former smoking, very high and very low alcohol consumption, and less PA were associated with significantly higher prevalence of cataract (Table 1). In the adjusted overall analysis, less than 600 MET-minutes/week of PA was associated with significantly higher odds (OR=1.324, 95% CI = 1.116–1.571) for cataract (Table 2). Advanced age and multimorbidity were also associated with significantly higher odds for cataract (Table 2). Age-stratified analyses showed that the association between PA and cataract was significant only in the age groups of 65-69 years and 50-69 years (Table 3).

DISCUSSION

To our knowledge, this is the first Spanish representative population-based study exploring the association between levels of PA with the prevalence of cataracts. Of note, the prevalence of cataracts (17.4%) among the eldest subjects (65-69) is lower than similar population based studies in Germany (25.2%; age ≥65)[20]. The differences in these prevalence rates are likely to be due to differences in population characteristics, such as different ages[1], different prevalence of diabetes[7,8] and different educational levels[3,9].

The multivariable logistic regression showed that performing fewer than 600 MET-minutes of PA per week was associated with 32.4% increased odds of cataract. These results concur with other studies that have found negative associations between PA levels and cataract risk[10,21,22]. For example, Selin et al.[10] found, in their population based study exploring PA and age-related cataract prevalence, that the least active subjects were 24% more likely to suffer with cataract than the most active group. Furthermore, Williams[22] found that running distance was significantly negatively associated with cataract risk.

To contextualize the magnitude of the impact of PA on cataracts, it may be useful to compare it with the impact of PA on other adverse health states. While in the present study performing fewer than 600 MET-minutes of PA per week was associated with 32.4% increased odds of cataract, in one other recent cross-sectional study in people with COPD residing in Spain[23] performing fewer than 600 MET-min/week was associated with 110.6% increased odds of urinary incontinence, 97.2% for chronic constipation, 82.5% for cataracts, 50.8% for chronic anxiety and 48.7% for chronic lumbar back pain.

As discussed in the introduction, the observed association between PA and cataracts is likely bidirectional, with low levels of PA activity increasing risk of cataract via inflammatory pathways[10] and cataracts reducing levels of PA through increasing levels of visual impairment[13,14].

The main strengths of this study were the large representative sample and the use of a validated, reliable and internationally recognised questionnaire to measure PA. However, the results of this study should be considered within its limitations. The age group of adults ≥70 years was not considered, as IPAQ short form is designed for the age range of 15-69 years. Assessment of PA and cataracts was self-reported, limiting

the ability to distinguish between the type of cataract and introducing scope for bias. It was not considered whether the participants had any other eye disease or they had had cataract surgery. Since cataract surgery is associated with higher PA[12], future studies should also consider this aspect. As alcohol consumption was evaluated through a 9-categories frequency question, it is recommended that future studies evaluate not only the frequency of consumption, but also the quantity and type of alcohol. Moreover, the cross-sectional nature of the study means the direction of the association is not known. While we hypothesise that it is likely bidirectional, future longitudinal studies are needed to clarify the direction of causality.

CONCLUSION

A significant association between physical activity and cataract was observed in a representative Spanish population. This adds further evidence and supports advice that men and women aged 50-69 years should be encouraged to be as physically active as possible.

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Table 1 – Sample characteristics.

Characteristic	**Category**	**N**	**Column %**	**N (%) with cataract[a]**		**N (%) without cataract[b]**		**P-value[c]**
Age 3 groups (years)	15–49	10089	56.8	45	(0.4)	10044	(99.6)	<0.001
	50–64	5977	33.6	322	(5.4)	5655	(94.6)	
	65-69	1711	9.6	297	(17.4)	1414	(82.6)	
Age 2 groups (years)	15–49	10089	56.8	45	(0.4)	10044	(99.6)	<0.001
	50–69	7688	43.2	619	(8.1)	7069	(91.9)	
Sex	Female	9248	52.0	374	(4.0)	8874	(96.0)	0.024
	Male	8529	48.0	290	(3.4)	8239	(96.6)	
Education	≤ Primary	3324	18.7	285	(8.6)	3039	(91.4)	<0.001
	Secondary	9004	50.6	253	(2.8)	8751	(97.2)	
	≥ Tertiary	5449	30.7	126	(2.3)	5323	(97.7)	
Multimorbidity	No	9247	52.0	90	(1.0)	9157	(99.0)	<0.001
	Yes	8530	48.0	574	(6.7)	7956	(93.3)	
Obesity (BMI ≥ 30 kg/m^2)	No	14424	83.5	465	(3.2)	13959	(96.8)	<0.001
	Yes	2849	16.5	176	(6.2)	2673	(93.8)	
	Missing	504						
Smoking	Never	8198	46.1	306	(3.7)	7892	(96.3)	<0.001
	Current	5071	28.5	148	(2.9)	4923	(97.1)	
	Former	4497	25.3	210	(4.7)	4287	(95.3)	
	Missing	11						
Alcohol Consumption	Daily or almost daily	2614	14.7	141	(5.4)	2473	(94.6)	<0.001
	5-6 days per week	278	1.6	14	(5.0)	264	(95.0)	
	3-4 days per week	712	4.0	25	(3.5)	687	(96.5)	
	1-2 days per week	3197	18.0	68	(2.1)	3129	(97.9)	
	2-3 days in a month	2206	12.4	45	(2.0)	2161	(98.0)	
	Once a month	1310	7.4	32	(2.4)	1278	(97.6)	
	Less than once a month	2075	11.7	60	(2.9)	2015	(97.1)	
	Not in the last 12 months, I have stopped drinking alcohol	2237	12.6	135	(6.0)	2102	(94.0)	
	Never or just a few sips to try it throughout life	3134	17.6	144	(4.6)	2990	(95.4)	
	Missing	14						
Physical activity (MET-minutes/week)	< 600	5366	30.2	253	(4.7)	5113	(95.3)	<0.001
	≥ 600	12411	69.8	411	(3.3)	12000	(96.7)	

Self-weighting sample.
Abbreviation: BMI (Body Mass Index).
[a] Number (and percentage) of individuals with that sample characteristic who have cataract.
[b] Number (and percentage) of individuals with that sample characteristic who do not have cataract.
[c] P-value was calculated with Chi-squared tests.

Table 2 – Association of physical activity and other covariates with cataract (outcome) estimated by multivariable logistic regression.

Characteristic		**Self-reported diagnosis of cataract**	
Physical activity (MET-minutes/week)	< 600 vs. ≥ 600	1.324**	[1.116, 1.571]
Age (years)	Per unit increase	1.133***	[1.120, 1.147]
Sex	Male vs. Female	1.005	[0.834, 1.210]
Education	≤ Primary	1.042	[0.821, 1.321]
	Secondary	0.913	[0.727, 1.146]
	≥ Tertiary	1.0	
BMI (kg/m^2)	Per unit increase	1.001	[0.999, 1.003]
Multimorbidity	Yes vs. No	2.728***	[2.156, 3.452]
Smoking	Former	1.035	[0.843, 1.269]
	Current	0.960	[0.770, 1.197]
	Never	1.0	
Alcohol consumption	Daily or almost daily	0.682**	[0.516, 0.901]
	5-6 days per week	0.941	[0.513, 1.726]
	3-4 days per week	0.805	[0.506, 1.281]
	1-2 days per week	0.690*	[0.501, 0.951]
	2-3 days in a month	0.628*	[0.437, 0.904]
	Once a month	0.757	[0.501, 1.144]
	Less than once a month	0.696*	[0.503, 0.964]
	Not in the last 12 months, I have stopped drinking alcohol	1.013	[0.778, 1.320]
	Never or just a few sips to try it throughout life	1.0	

Self-weighting sample.
Abbreviation: BMI (Body Mass Index).
Estimates are odds ratio [95% confidence interval].
Models are adjusted for all variables in the Table.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 3 – Association between physical activity and cataract (outcome) by age groups estimated by multivariable logistic regression.

Three Age Groups (years)	**Association between physical activity and cataract (outcome)**	
15–49	1.461	[0.796, 2.680]
50–64	1.135	[0.895, 1.440]
65-69	1.529**	[1.168, 2.003]
Two Age Groups (years)	**Association between physical activity and cataract (outcome)**	
15–49	1.461	[0.796, 2.680]
50–69	1.207*	[1.014, 1.437]

Self-weighting sample.
Estimates are odds ratio [95% confidence interval].
Models are adjusted for sex, education, BMI (Body Mass Index), multimorbidity, smoking, and alcohol consumption.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

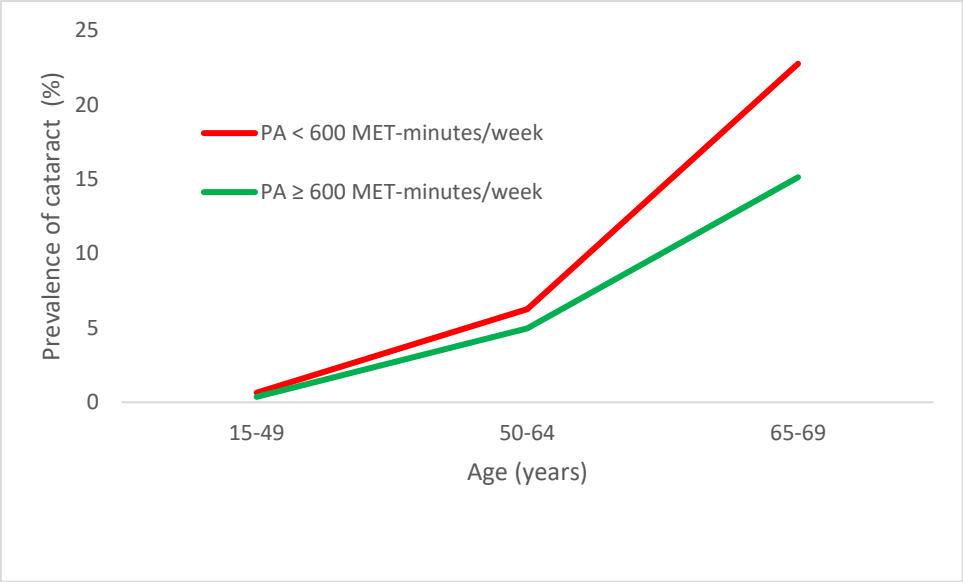

Figure 1a – Prevalence of cataract by level of physical activity (PA) and by 3 age groups.

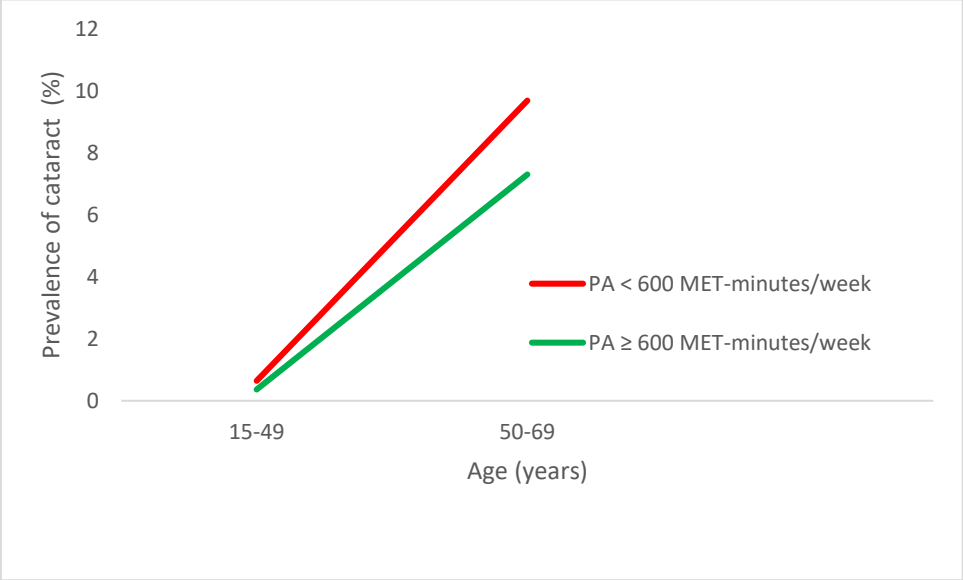

Figure 1b – Prevalence of cataract by level of physical activity (PA) and by 2 age groups.