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Comparison of physical activity levels in Spanish people with diabetes with and without cataracts

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Background: The objective was to compare levels of physical activity (PA) in a large sample of Spanish people with diabetes with and without cataracts. To our knowledge, this is the first study comparing PA levels in people with diabetes with and without cataracts in a large representative sample. **Methods:** Cross-sectional data from the Spanish National Health Survey 2017 were analyzed ($n = 1014$ people with diabetes; 43.1% females; age range 15–69 years; mean age 58.4 ± 9.2 years). International Physical Activity Questionnaire (IPAQ) short form was used to measure PA. Total MET-min week^{-1} of PA were calculated and participants were divided into two categories according to American Diabetes Association PA guidelines: (i) <600 MET-min week^{-1}. (ii) At least 600 MET-min week^{-1}. Diabetes and cataracts were self-reported in response to the questions 'Have you ever been diagnosed with diabetes/cataracts?' Participants also reported other variables including age, gender, marital status, living as a couple, education, smoking, alcohol consumption and obesity. Statistical analysis was performed with SPSS 23.0. **Results:** The overall prevalence of cataract was 14.0% and the overall prevalence of people doing <600 MET-min week^{-1} of PA was 35.4%. The prevalence of cataract was significantly lower in those doing more PA (12.1% vs. 17.5%; $P = 0.016$). Those without cataracts were significantly more active than those with cataracts (1846.8 vs. 1289.4 MET-min week^{-1}; $P = 0.001$). The adherence to American Diabetes Association PA guidelines was significantly higher in those without cataracts (66.1% vs. 55.6%; $P = 0.016$). **Conclusions:** Interventions to promote PA targeting people with both diabetes and cataracts are warranted.

Introduction

Approximately 422 million people worldwide have diabetes[1] and it is estimated that cataracts affect 95 million people globally, being one of the leading causes of reversible blindness.[2,3] Diabetes can affect different ocular structures, with cataracts being a common ocular complication.[3–6] Previous literature has also showed that several other factors are implicated in the development of cataracts, such as old age,[2] female sex,[7,8] high exposure to UV rays,[9] systemic medications, such as steroids and hypertension.[6,10]

Several studies have identified significant associations between physical activity (PA) and cataract risk. A recent population-based prospective cohort study with 52 660 participants (23 853 women and 28 807 men) aged 45–83 years from Sweden suggested that long-term high total PA levels (>45.5 MET-h day^{-1}) were statistically significantly associated with a 24% decreased risk of cataract compared with long-term low total PA (<38.4 MET-h day^{-1}).[11] Another cross-sectional population-based study with 17 777 people (52% females) aged 15–69 years residing in Spain found that performing fewer than 600 MET-min week^{-1} of PA was associated with 32.4% increased odds of cataract.[12]

The association between PA and cataracts could be due to several mechanisms. Higher concentration of C-reactive protein is associated with higher odds of cataracts, while more PA is associated with lower levels of C-reactive proteins.[11] PA is also associated with better insulin resistance and a lower risk of diabetes, which are both associated with higher risk of cataracts.[11] Also, cataracts can produce visual impairment that is associated with lower PA.[12] Consequently, the association between cataracts and PA is likely bi-directional.

Other studies have investigated levels of PA in people with diabetes with and without diabetic eye disease. For example, a study carried out on 199 people with diabetes residing in China showed that there were no significant differences in PA levels between the two groups.[13] Another study on 81 Spanish people with diabetes also found no significant differences in the levels of PA between those with and without diabetic eye disease.[14] However, these two previous studies have important limitations: first they did not analyze cataracts independently and they contain small samples and thus likely not nationally representative.

Therefore, considering the benefits that PA can produce in people with diabetes and cataracts, epidemiological studies with larger and representative samples comparing PA levels in people with diabetes with and without cataracts are needed. The aim of this study was to compare the levels of PA in a large sample of Spanish people with diabetes with and without cataracts. As previous literature has identified that in general population low PA is significantly associated with increased cataract risk,[11,12] it was hypothesized that people with

diabetes who have cataracts would be significantly less active than those who do not have cataracts.

Methods

The survey

Data from the Spanish National Health Survey 2017 were analyzed. This survey was carried out in Spain between October 2016 and October 2017. Details of the survey methods have been published elsewhere.[15] In brief, for the data collection, a stratified three-stage sampling technique 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.

Participants

The sample was representative of the population aged 15–69 years with diabetes residing in Spain, and consisted of 1014 people with diabetes aged 15–69 years (mean age 58.4 ± 9.2 years; 56.9% male). The age group of people ≥70 years was not considered in this study, as they did not complete the International Physical Activity Questionnaire (IPAQ) short form; IPAQ short form is an instrument designed primarily for population surveillance of PA among adults (age range 15–69 years), and it has been developed and tested for use in this population, and until further development and testing is undertaken, the use of IPAQ with older and younger age groups is not recommended.[16]

Procedure

The method of data collection used was computer-assisted personal interviewing, 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. This study received ethical approval of the Spanish Statistical Office and was conducted in accordance with the Declaration of Helsinki of the World Medical Association.

Physical activity

The IPAQ short form was used to measure PA. The unit of PA used was MET-min week^{-1}, where MET is the Metabolic Equivalent of Task. Total PA MET-min week^{-1} were calculated through the following formula: *sum of Walking + Moderate + Vigorous MET-min week^{-1} scores*.[16] Participants were divided in two categories according to the guidelines for data processing and analysis of the IPAQ[16] and according to the American Diabetes Association PA guidelines[17]: (i) fewer than 600 MET-min week^{-1} and (ii) at least 600 MET-min week^{-1}, equivalent to meeting current PA recommendations. IPAQ has been validated in adult populations from different countries showing acceptable validity ($\rho = 0.30$, 95% CI: 0.23–0.36) and reliability (Spearman's $\rho = 0.81$, 95% CI: 0.79–0.82).[18] Specifically, IPAQ Short Form has been validated among Spanish university students showing adequate validity.[19]

Diabetes and cataracts

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

Co-variates

The selection of the control variables was based on past literature.[2,20,21] Sociodemographic variables included age, sex, marital status, living in couple and education. Education was based on the highest educational level achieved and was categorized as ≤ primary, secondary and ≥ tertiary. Marital status was categorized as married and single/widowed/divorced/separated. Living in as a couple was categorized as yes/no. Smoking status was self-reported and categorized as never, current smoker and past smoker. Alcohol consumption in the last 12 months was self-reported and categorized as yes (any) and no (none). Height and weight were self-reported. Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared. Obesity was defined as BMI ≥30 kg m^{-2}, according to World Health Organization (https://www.who.int/topics/obesity).

Statistical analysis

The statistical analysis was performed with SPSS 23.0 (IBM, NY, USA). The Kołmogorov–Smirnov test was applied to check normality and the Levene test was used to check homogeneity of variance. Differences in sample characteristics (overall and by cataracts status) were assessed by χ^2 tests, except for age (independent samples *t*-test). The total amount of PA in MET-min week^{-1} (overall, by cataracts status and by sample characteristics) was analyzed using independent samples *t*-test, providing the mean and standard deviation of each group, mean difference, *t*-value, degrees of freedom (*df*) and *P*-values. The adherence to American Diabetes Association PA guidelines (overall, by cataracts status and by sample characteristics) was evaluated by χ^2 tests. In addition, the effect size was calculated using Cohen's *d*, classified as small (0.20), medium (0.50) and large (0.80).[22] There were missing data only on the following variables: marital status (3:0.30%), living as a couple (6:0.59%), smoking (1:0.10%) and obesity (27:2.66%). 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). The level of statistical significance was set at $P < 0.05$.

Results

In this self-weighting sample of 1014 people with diabetes residing in Spain, the overall prevalence of cataract was 14.0% and the overall prevalence of those participating in <600 MET-min week^{-1} of PA (American Diabetes Association PA guidelines) was 35.4%. Overall, the prevalence of cataract among those doing less and more than 600 MET-min week^{-1} of PA was 17.5% and 12.1%, respectively ($P = 0.016$). Based on unadjusted estimates, advanced age, lower education, no alcohol consumption and obesity were associated with significantly higher prevalence of cataract (table 1). In the overall analysis, people with cataracts were significantly less active than those without cataracts (1289.4 vs. 1846.8 MET-min week^{-1}; $P = 0.001$). Stratified analyses showed that this difference was significant in females, in both age groups (≤60 and >60 years), in those not married, in those who did not live as a couple, in current smokers and in those who drank alcohol. The effect size was large in those ≤60 years and medium in current smokers (table 2). In the overall analysis, the adherence to American Diabetes Association PA guidelines was significantly ($P = 0.016$) higher in people without cataracts (66.1%) than in those with cataracts (55.6%). Stratified analyses identified significant differences in males, in those ≤60 years, in those married and in those living as a couple (table 3).

Discussion

To our knowledge, this is the first study comparing PA levels in people with diabetes with and without cataracts in a large representative sample. The main findings of this study were (i) overall

Table 1 Sample characteristics (overall and by cataracts status)

Characteristics	Category	Overall	Cataracts		*P*-value[a]
			No	Yes	
Overall	–	1014 (100.0)	872 (86.0)	142 (14.0)	<0.001***
Sex	Male	577 (56.9)	498 (86.3)	79 (13.7)	0.742
	Female	437 (43.1)	374 (85.6)	63 (14.4)	
Age	Average (SD)	58.4 (9.2)	58.2 (9.4)	59.9 (7.3)	0.014*
	≤60	502 (49.5)	474 (94.4)	28 (5.6)	0.436
	>60	512 (50.5)	398 (77.7)	114 (22.3)	
Marital status	Married	649 (64.2)	563 (86.7)	86 (13.3)	0.330
	Single/widowed/ divorced/separated	362 (35.8)	306 (84.5)	56 (15.5)	
	Missing	3			
Living in couple	Yes	651 (64.6)	563 (86.5)	88 (13.5)	0.483
	No	357 (35.4)	303 (84.9)	54 (15.1)	
	Missing	6			
Education	≤Primary	426 (42.0)	342 (80.3)	84 (19.7)	<0.001***
	Secondary	437 (43.1)	387 (88.6)	50 (11.4)	
	≥Tertiary	151 (14.9)	143 (94.7)	8 (5.3)	
Smoking	Never	371 (36.6)	316 (85.2)	55 (14.8)	0.815
	Past	386 (38.1)	335 (86.8)	51 (13.2)	
	Current	256 (25.3)	220 (85.9)	36 (14.1)	
	Missing	1			
Alcohol	No	432 (42.6)	356 (82.4)	76 (17.6)	0.005**
	Yes	582 (57.4)	516 (88.7)	66 (11.3)	
Obesity	No	605 (61.3)	534 (88.3)	71 (11.7)	0.019*
	Yes	382 (38.7)	317 (83.0)	65 (17.0)	
	Missing	27			

Values are expressed in frequencies (%). Age expressed in average (standard deviation: SD).
a: *P*-values were based on χ^2 tests except for age (*t*-test).
*: $P<0.05$. **$P<0.01$. ***$P<0.001$.

Table 2 Total amount of PA in MET-min week^{-1} (overall, by cataracts status and by sample characteristics)

Characteristics	Category	Overall (*N* = 1014)	Cataracts		Dif.	*t*	df	*P*-value [a]	*d* [b]
			No (*N* = 872)	Yes (*N* = 142)					
Overall		1768.7 (2695.6)	1846.8 (2823.1)	1289.4 (1644.8)	557.4	3.320	297.6	0.001**	0.3004
Sex	Male	1737.6 (2480.1)	1799.2 (2571.8)	1349.4 (1760.9)	449.8	1.499	575	0.134	0.1815
	Female	1809.8 (2958.8)	1910.1 (3128.9)	1214.2 (1497.0)	695.9	2.801	171.4	0.006**	0.3815
Age	≤60	540.5 (745.7)	596.5 (778.2)	170.0 (270.2)	426.5	8.539	267.7	<0.001***	**1.6607**
	>60	2973.0 (3305.2)	3097.1 (3495.5)	2261.5 (1721.2)	835.5	3.228	203.479	0.001**	0.3429
Marital status	Married	1778.2 (2732.6)	1846.2 (2849.5)	1333.6 (1734.9)	512.5	1.622	647	0.105	0.1878
	Single/widowed/ divorced/ separated	1765.1 (2639.1)	1864.6 (2787.3)	1221.5 (1508.6)	643.0	2.503	135.645	0.014*	0.3638
Living in couple	Yes	1797.2 (2748.7)	1864.5 (2869.1)	1366.6 (1747.9)	497.8	1.582	649	0.114	0.1813
	No	1729.0 (2614.9)	1829.8 (2759.4)	1163.6 (1468.3)	666.2	2.612	131.572	0.010*	0.3858
Education	≤Primary	1544.5 (2389.8)	1638.5 (2539.2)	1161.7 (1603.2)	476.8	1.642	424	0.101	0.2
	Secondary	2026.5 (3168.7)	2091.5 (3300.8)	1523.0 (1794.6)	568.5	1.194	435	0.233	0.1794
	≥Tertiary	1655.4 (1832.5)	1682.6 (1868.2)	1170.0 (933.4)	512.6	0.769	149	0.443	0.2794
Smoking	Never	1728.6 (2589.4)	1812.7 (2713.8)	1245.2 (1643.5)	567.5	1.503	369	0.134	0.2196
	Past	1862.1 (2479.3)	1909.8 (2552.8)	1548.3 (1918.5)	361.6	0.970	384	0.333	0.1458
	Current	1692.6 (3134.6)	1807.5 (3337.9)	990.3 (1131.5)	817.2	2.783	155.324	0.006**	**0.5003**
Alcohol	No	1601.4 (2399.8)	1681.9 (2539.3)	1224.2 (1549.2)	457.8	1.512	430	0.131	0.1911
	Yes	1892.9 (2891.5)	1960.5 (3000.4)	1364.5 (1757.4)	595.9	2.351	120.392	0.020*	0.3073
Obesity	No	2053.4 (3062.2)	2111.9 (3175.6)	1613.9 (1975.3)	497.9	1.288	603	0.198	0.1627
	Yes	1383.9 (1995.3)	1459.7 (2117.5)	1014.4 (1180.9)	445.3	1.643	380	0.101	0.2237

Values are expressed as average (standard deviation: SD).
a: *P*-values were based on *t*-test.
b: Cohen's *d*: small 0.20; medium 0.50; large 0.80.
*: $P<0.05$. **$P<0.01$. ***$P<0.001$.

prevalence of cataract was 14.0%; (ii) overall prevalence of people doing <600 MET-min week^{-1} of PA was 35.4%; (iii) the prevalence of cataract was significantly lower in those doing >600 MET-min week^{-1}; (iv) people without cataracts were significantly more active; (v) adherence to American Diabetes Association PA guidelines was significantly higher in people without cataracts.

The prevalence of cataracts in people with diabetes studied was 14.0%. This is lower than in previous research that studied the prevalence of cataracts among people with diabetes in Sweden and India.[23,24] These different rates could be due to differences in population characteristics, such as different ages[2] and different sex distribution.[7,8] Also, other cataract risk factors that are likely different

Table 3 Adherence to American Diabetes Association physical activity guidelines (> 600 MET-min week^{-1}) (overall, by cataracts status and by sample characteristics)

Characteristics	Category	Overall ($N = 1014$)	Cataracts		Dif.	χ^2	*df*	*P*-value [a]	*d* [b]
			No ($N = 872$)	Yes ($N = 142$)					
Overall		655 (64.6)	576 (66.1)	79 (55.6)	10.5	5.799	1	0.016*	0.1517
Sex	Male	378 (65.5)	336 (67.5)	42 (53.2)	14.3	6.176	1	0.013*	0.208
	Female	277 (63.4)	240 (64.2)	37 (58.7)	5.5	0.688	1	0.407	0.0794
Age	≤60	143 (28.5)	140 (32.1)	3 (4.5)	27.6	21.380	1	<0.001***	0.4218
	>60	512 (100.0)	436 (100.0)	76 (100.0)	—	—	—	—	—
Marital status	Married	415 (63.9)	369 (65.5)	46 (53.5)	12.0	4.701	1	0.030*	0.1708
	Single/widowed/ divorced/separated	240 (66.3)	207 (67.6)	33 (58.9)	8.7	1.610	1	0.204	0.1337
Living in couple	Yes	417 (64.1)	370 (65.7)	47 (53.4)	12.3	0.1761	1	0.025*	0.1761
	No	235 (65.8)	203 (67.0)	32 (59.3)	7.7	1.220	1	0.269	0.1171
Education	≤Primary	251 (58.9)	209 (61.1)	42 (50.0)	11.1	3.440	1	0.064	0.1805
	Secondary	300 (68.6)	269 (69.5)	31 (62.0)	7.5	1.160	1	0.281	0.1032
	≥Tertiary	104 (68.9)	98 (68.5)	6 (75.0)	−6.5	0.148	1	0.701	0.0626
Smoking	Never	238 (64.2)	209 (66.1)	29 (52.7)	13.4	3.664	1	0.056	0.1997
	Past	262 (67.9)	232 (69.3)	30 (58.8)	10.5	2.208	1	0.137	0.1517
	Current	155 (60.5)	135 (61.4)	20 (55.6)	5.8	0.437	1	0.509	0.0827
Alcohol	No	254 (58.8)	360 (69.8)	41 (62.1)	7.7	2.946	1	0.086	0.1657
	Yes	401 (68.9)	216 (60.7)	38 (50.0)	10.7	1.597	1	0.206	0.1049
Obesity	No	418 (69.1)	374 (70.0)	44 (62.0)	8.0	1.909	1	0.167	0.1125
	Yes	224 (58.6)	191 (60.3)	33 (50.8)	9.5	2.000	1	0.157	0.1451

Values expressed in frequencies (%).
a: *P*-values were based on χ^2 tests.
b: Cohen's *d*: small 0.20; medium 0.50; large 0.80.
*: $P < 0.05$. **$P < 0.01$. ***$P < 0.001$.

in Sweden and India in comparison with Spain are different levels of exposure to UV rays,[9] different prevalences of hypertension[6,10] or different educational levels.[7,25]

The overall prevalence of people who did not achieve the American Diabetes Association PA recommendation was 35.4%. This prevalence is lower than the only previous study carried out with 81 Spanish people with diabetes aged 15–66 years,[14] in which only 16.1% did <600 MET-min week^{-1} of PA. This difference is probably due to the different sample sizes ($n = 1014$ in the present study), being possible that the previous study underestimated this prevalence.

The prevalence of cataract was significantly lower in those people doing >600 MET-min week^{-1} of PA (12.1 vs. 17.5%; $P = 0.016$) and people without cataracts were significantly more active than those with cataracts (1846.8 vs. 1289.4 MET-min week^{-1}; $P = 0.001$). These results are consistent with previous studies who found higher levels of PA in people with diabetes without diabetic eye disease[13] and in people without difficulty seeing.[21] A possible explanation for this result is a bi-directional association between cataracts and PA, with low PA increasing the risk of cataract through inflammatory pathways[11] and cataracts reducing PA levels due to difficulty seeing.[12,21]

The present findings also suggest that the levels of PA in people with both diabetes and cataracts were significantly lower in females, in those not married and in those who did not live as a couple, in current smokers and in those who drank alcohol. As it has been reported in previous studies,[12–14,21] these specific populations are at higher risk of lower levels of PA and, therefore, interventions to promote PA targeting these specific population groups are warranted.

Strengths of the present study include the large representative sample of people with diabetes residing in Spain and the use of the IPAQ short form, an instrument that is reliable, valid and internationally accepted to measure PA in epidemiological research. However, findings from the present study should be interpreted in light of its limitations. PA, diabetes and cataracts were self-reported, introducing scope for bias. Cataract surgery was not considered because this variable was not included in the survey and, therefore, we recommend that future studies also considered this aspect. Finally, this study was cross-sectional and thus the direction of the observed association is not known. Although it is likely bi-directional, it is now recommended to carry out longitudinal studies and randomized controlled trials to clarify the direction of the observed association.

Conclusion

Those people with both diabetes and cataracts were significantly less active and had significantly less adherence to the American Diabetes Association PA guidelines than those without cataracts, the research hypothesis is thus accepted. The main implications and practical applications derived from this study refer to the necessity of promoting PA in people with both diabetes and cataracts. Therefore, interventions to promote PA targeting people with both diabetes and cataracts are warranted, and these interventions should be designed by multidisciplinary teams composed of professionals of public health, PA sciences and vision sciences.

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Conflict of interest: None declared.

Key points

- Those without cataracts were more active than those with cataracts.
- Adherence to physical activity guidelines was higher in those without cataracts.
- Promotion of physical activity in people with diabetes and cataracts is needed.

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