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

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**Abstract**

**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 analysed (n=1,014 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-minutes/week of PA were calculated, and participants were divided into two categories according to American Diabetes Association PA guidelines: (1) Less than 600 MET-minutes/week. (2) At least 600 MET-minutes/week. 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 less than 600 MET-minutes/week 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 (1,846.8 vs 1,289.4 MET-minutes/week; 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.

**Keywords:** Physical activity; diabetes; cataracts; diabetic eye disease; diabetic retinopathy.

**1. INTRODUCTION**

Approximately 422 million people worldwide have diabetes1 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 to 83 years from Sweden suggested that long-term high total PA levels (>45.5 MET-hours/day) were statistically significantly associated with a 24% decreased risk of cataract compared with long-term low total PA (<38.4 MET-hours/day). 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-minutes/week 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 bidirectional.

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 risk11,12, it was hypothesized that people with diabetes who have cataracts would be significantly less active than those who do not have cataracts.

**2. METHODS**

2.1. 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.

2.2. Participants

The sample was representative of the population aged 15-69 years with diabetes residing in Spain, and consisted of 1,014 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 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

2.3. Procedure

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. 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.

2.4. Physical activity

The 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. 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 IPAQ16 and according to the American Diabetes Association PA guidelines17: (1) fewer than 600 MET-minutes/week and (2) at least 600 MET-minutes/week, equivalent to meeting current PA 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).18 Specifically, IPAQ Short Form has been validated among Spanish university students showing adequate validity.19

2.5. 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.

2.6. 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 meters squared. Obesity was defined as BMI ≥ 30 kg/m2, according to World Health Organization (<https://www.who.int/topics/obesity>).

2.7. 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 Chi-squared tests, except for age (independent samples *t*-test). The total amount of PA in MET-minutes/week (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*-value. The adherence to American Diabetes Association PA guidelines (overall, by cataracts status and by sample characteristics) was evaluated by Chi-squared 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.

**3. RESULTS**

In this self-weighting sample of 1,014 people with diabetes residing in Spain, the overall prevalence of cataract was 14.0%, and the overall prevalence of those participating in less than 600 MET-minutes/week of PA (American Diabetes Association PA guidelines) was 35.4%. Overall, the prevalence of cataract among those doing less and more than 600 MET-minutes/week 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 (1,289.4 vs 1,846.8 MET-minutes/week; 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).

**4. 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 prevalence of cataract was 14.0%; (ii) overall prevalence of people doing less than 600 MET-minutes/week of PA was 35.4%; (iii) the prevalence of cataract was significantly lower in those doing more than 600 MET-minutes/week; (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 ages2 and different sex distribution.7,8 Also, other cataract risk factors that are likely different in Sweden and India in comparison with Spain are different levels of exposure to UV rays,9 different prevalences of hypertension6,10 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 less than 600 MET-minutes/week 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 more than 600 MET-minutes/week of PA (12.1% vs. 17.5%; p=0.016), and people without cataracts were significantly more active than those with cataracts (1,846.8 vs 1,289.4 MET-minutes/week; p=0.001). These results are consistent with previous studies who found higher levels of PA in people with diabetes without diabetic eye disease13 and in people without difficulty seeing.21 A possible explanation for this result is a bidirectional association between cataracts and PA, with low PA increasing the risk of cataract through inflammatory pathways11 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 consider also this aspect. Finally, this study was cross-sectional, and thus the direction of the observed association is not known. Although it is likely bidirectional, it is now recommended to carry out longitudinal studies and randomized controlled trials to clarify the direction of the observed association.

**5. 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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**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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**Table 1.** Sample characteristics (overall and by cataracts status)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Characteristics | Category | Overall | Cataracts | P-valuea |
| 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 expressed in Frequencies (%). Age expressed in Average (Standard Deviation: SD).

a P-values were based on chi-squared tests except for age (t-test). \* P < 0.05. \*\* P < 0.01. \*\*\* P < 0.001.

**Table 2.** Total amount of physical activity in MET-minutes/week (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 Average (Standard Deviation: SD).

a P-values were based on t-test. \* P < 0.05. \*\* P < 0.01. \*\*\* P < 0.001.

b Cohen's *d*: Small 0.20; **Medium 0.50; Large 0.80.**

**Table 3.** Adherence to American Diabetes Association physical activity guidelines (> 600 MET-minutes/week) (overall, by cataracts status and by sample characteristics)

| Characteristics | Category | Overall (N=1014) | Cataracts | Dif. | *χ2* | 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 chi-squared tests. \* P < 0.05. \*\* P < 0.01. \*\*\* P < 0.001.

b Cohen's *d*: Small 0.20; Medium 0.50; Large 0.80.