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Relationship between Physical Activity and Medicine Use in the Spanish Population

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Citation: Denche-Zamorano, Á.; Garcia-Gordillo, M.Á.; Pastor-Cisneros, R.; Contreras-Barraza, N.; Carlos-Vivas, J.; Colmenarez-Mendoza, A.; Adsuar-Sala, J.C. Relationship between Physical Activity and Medicine Use in the Spanish Population. *Sustainability* **2022**, *14*, 13615. https://doi.org/10.3390/su142013615

Academic Editor: Gianpiero Greco

Received: 8 September 2022
Accepted: 19 October 2022
Published: 20 October 2022

Abstract: Health care costs in first world populations are rising, partly due to increased use of medicines. Sedentary lifestyles and global demographic ageing have contributed to this. A physically more active population could reduce the use of medicines. The aim is to analyse the relationships between physical activity level (PAL) and medication use in the Spanish population, by sexes and age groups. Methods: A cross-sectional study with 17,199 participants, from the Spanish National Health Survey 2017. A study of normality: Normality was studied using the Kolmogorov–Smirnov test. A descriptive analysis was performed to characterise the sample. Non-parametric statistical tests were used: chi-square statistics (ordinal variables) and a Mann–Whitney U test (continuous variables) to analyse intergroup differences. A correlation study was carried out—Spearman's rho—between medication use and PAL. A multiple binary logistic regression was performed, taking medication use as the dependent variable and PAL, sex, age and social class, as independent variables. Two-sided p-values ≤ 0.05 were considered statistically significant. Results: Relationships were found between PAL and the use of medication ($p < 0.001$). Performing moderate and/or vigorous PA was related to a lower use of medication compared to just walking or being inactive ($p < 0.05$). Weak correlations were found between PAL and medication use ($p < 0.001$). People with a low physical activity level shown to be at higher risk of using medications. Conclusion: High levels of PA are related to lower medication use in the Spanish population. Among all population groups, physically inactive people had a higher prevalence of medication use. Future research is needed to establish causal relationships and to propose optimal physical activity doses for each population group.

Keywords: physical activity; health; medication; health care costs

1. Introduction

Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that requires energy expenditure [1,2]. It is a practice that has positive effects and, therefore, PA is usually taken as an indicator of health behaviour [3,4]. In this way, the relationship between physical inactivity and increased health care costs, due to a high needed for medication, has been documented [5]. People with low levels of PA consume more medication, which is related to mental health problems such as anxiety or depression [6]. Moreover, physical inactivity can aggravate potential or previous pathologies, such as coronary artery disease, diabetes, etc., and there is evidence of an increase in the use of medication in people with metabolic syndrome, requiring the prescription of a greater amount of medication to treat cardiovascular and endocrine problems [7]. This low level of vigorous and/or moderate PA has also been associated with increased medication use and polypharmacy in adult people at risk for osteoarthritis of the knee [8].

In this regard, a recent study addressed the direct and indirect costs associated with physical inactivity in more than 140 countries [9]. Specifically in Spain (for the year 2013), these costs accounted for 1.53% of total healthcare expenditure, where 90% were healthcare direct costs and around 70% were financed by public health [9]. In 2015, the percentage of total national health care expenditure attributable to physical inactivity was still estimated at 1.03% [10].

Increasingly, several school-based programs are being implemented to encourage the practice and importance of PA from an early age [11–13]. In studies focused on pre-schoolers, no significant benefits are reported given that this is a very early age, where habits are still similar in most of the children [14]. However, studies carried out with school children, young people and older adults reported clear benefits in terms of health (decrease blood pressure and body fat percentage, emotional intelligence enhancement) [15,16]. Therefore, it is expected that by continuing with these PA promotion programs in all scenarios, a trend in the reduced use of medication in retirement can be observed. Suffering from unstable emotional intelligence may also imply higher healthcare costs for those affected. In this regard, the study led by Vaquero-Solís et al. [17] showed a clear positive relationship between physical activity and higher emotional intelligence scores, i.e., those people who practice more physical activity present a greater emotional intelligence.

Focusing on health care costs, it is important to note that age is a variable that has a smaller effect on the cost and utilisation of health care services than might be expected. Countries such as Japan and Germany, with high rates of older adults (over 65 years old), spend less on health care costs than other populations with smaller adult populations, such as African countries [18]. In Japan, PA has been used as a predictor of the development of frailty in participants. Given that frailty represents a vulnerable physiological state, to the extent that PA improves this indicator, it decreases health care and thus polypharmacy [19].

Based on the above, this study aimed to explore the relationships between different PA levels (PAL) and the use of medicines in the Spanish population (18–69 years), stratified by sex and age groups in the pre-pandemic period, providing information on these relationships for future comparative research in the Spanish population in post-pandemic periods, by analysing data from the Spanish National Health Survey 2017 (ENSE2017), the latest provided by the Spanish Ministry of Health, Consumer Affairs and Social Welfare (MSCBS), on the health status of residents in Spain before Covid19. The main hypothesis was: PAL will be inversely related to medication use in the Spanish population, that is, the population with lower PAL has a higher medication use than the physically active population.

2. Materials and Methods

2.1. Study Design

This is a cross-sectional study based on data extracted from microdata provided by the MSCBS from the ENSE 2017, adult questionnaire [20]. The MSCBS, together with the National Statistics Institute (INE), conducts such a survey every five years, collecting information on health status, as well as the use of and access to health services, among other determinants of health. Accredited interviewers conducted the ENSE surveys between October 2016 and October 2017. All the methodological information of the survey, including stratified random sampling system, sample calculation, evaluators, conditions under which the surveys were conducted, among other details, were collected in the document "National Health Survey 2017. Methodology" [21].

2.2. Participants

The ENSE 2017 selected its participants randomly, through a stratified three-phase sampling among the Spanish population aged 15–103 years [21]. A total of 23,089 people were interviewed: 10,595 men and 12,494 women. For our study, the inclusion criteria were: being at least 18 years old (+18 years) and under 70 years old. We excluded 578 participants for being minors in Spain (under 18 years old), and 5312 participants over 70 years old, as they were not questioned for their PA in the ENSE 2017, resulting in a final sample of 17,199 participants: 8238 men and 8961 women.

2.3. Ethical Considerations

As the data were obtained from non-confidential public files by Regulation (EU) 2016/679 of the European Parliament and Council of 27 April 2016 on the protection of natural persons about the processing of personal data and the free movement of such data, approval by an accredited ethics committee was not required.

2.4. Variables and Procedures

The following variables, extracted or derived from the ENSE 2017, were used:

Age: Collected in numerical values in the ENSE 2017, age was used to characterise the sample and make groupings. Participants aged between 18 and 64 years were considered. The age groupings were: youth (18–34 years), young adults (35–49 years), older adults (50–64 years) and seniors (65–69 years) [22,23]. We excluded 578 participants under the age of 18 years, and 5312 participants because they were older than 69 years.

Sex: Used to characterise and group the sample into men and women.

Social class: The ENSE 2017 grouped participants into 6 social classes, according to the definition of the Health Determinants Taskforce of the Spanish Society of Epidemiology: Class I (Directors and managers of establishments with 10 or more employees and professionals traditionally associated with university degrees), Class II (Directors and managers of establishments with less than 10 employees, professionals traditionally associated with university degrees and other technical support professionals. Sportsmen and artists), Class III (Intermediate occupations and self-employed workers), Class IV (Supervisors and workers in skilled technical occupations), Class V (Skilled primary sector workers and other semi-skilled workers) and Class VI (Unskilled workers).

Physical Activity Index (PAI) [24]: In the ENSE 2017, questions on PA were included, using the International Physical Activity Questionnaire (IPAQ) in its Spanish version [25]. The IPAQ asks participants about the frequency, duration and intensity of PA performed, in any type of situation: at work, at home, in leisure time, or in sports, in the last 7 days before being surveyed (Q113 Introduction: "We also ask you to answer the following questions about the time you spent in physical activity in the last 7 days". "Think about the activities you do as part of your work, at home, to get from one place to another and also those you do in your free time, exercise or sport". PA was considered: vigorous (PA requiring a great physical effort that makes you breathe much harder than normal, such as heavy lifting, digging, aerobic exercise or fast pedalling on a bicycle), moderate (PA requiring a moderate physical effort that makes you breathe a little harder than normal, such as carrying light weights, riding a bicycle at regular speed or playing doubles tennis) and walking.

The PAI was calculated, based on an adaptation of the Physical Activity Index [26], by applying a series of factors to the answers given by participants to the IPAQ questions [24].

The formula was:

$$\text{PAI} = (\text{intensity factor for intense activity} \times \text{frequency factor for intense activity} \times \text{duration factor for intense activity}) + (\text{intensity factor for moderate activity} \times \text{frequency factor for moderate activity} \times \text{duration factor for moderate activity})$$

The factors were applied to the different answers given by IPAQ participants to the intensity, frequency and duration questions; these factors are shown in Table 1 [26].

Table 1. Factors applied in the calculation of the PAI.

Intensity factors	Intense Activity (10). Moderate Activity (5). These factors were multiplied by the answers given to items: p. 113 (*How many days did you do intense PA?*) and p. 115 (*How many days did you do moderate PA?).*
Factors frequency	The following factors were applied to the responses to items p. 113 and p. 115: No day (0); One day (1); Two or three days (2); More than three days (3).
Factors duration	To the responses given to items p. 114 (*On one of those days, how much time did you spend in total on intense PA?*) and p.116 (*On one of those days, how much time did you spend in total on moderate PA?*) the following factors were applied: Less than 30 min (1); 30 or more minutes (1.5).

The PAI could take values between 0 and 67.5 points, adding up to a maximum of 45 points for intense PA and 22.5 points for moderate PA [24]. For analyses including this variable, 58 participants were excluded for answering "NS/NC" to the frequency and duration of intense PA, items Q.113 (17) and Q.114 (13), and to the frequency and duration of moderate PA, items Q.115 (12) and Q.116 (16).

Physical Activity Level (PAL): Based on the PAI, six PAL groups were formed. Two levels corresponded to people who did not perform moderate and/or intense PA (PAI = 0). The other four levels corresponded to people who did perform moderate and/or intense PA, calculating the percentiles, 75, 90, 95 and higher, concerning the PAI of all the participants of the ENSE 2017, to group these four groups. Considered: Inactive: people with PAI = 0; responded to Q.117 ("Now think about how much time you spent walking in the last 7 days") of the ENSE 2017, "No day more than 10 min in a row." Walkers: People with PAI = 0; stated in Q.117 of the 2017 DHS, to have walked at least one day a week for more than 10 min in a row. Low: People with a PAI between 1 and 15 (75th percentile). Medium: People with a PAI between 16–30 (90th percentile). High: People with a PAI between 31–45 (95th percentile). Very high: People with a PAI above 45 (values above the 95th percentile).

Medication use: data were taken from item p.85 of the ENSE 2017, "During the last 2 weeks, have you taken any medicine that was prescribed to you by a doctor?", with answers: "Yes" or "No".

2.5. Statistical Analysis

IBM SPSS Statistics v.25 statistical software was used. The normality of the data distributions of the variables was studied using the Kolmogorov–Smirnov test. The samples were characterised based on descriptive analysis, presenting the variables, age and PA index, according to the central values, median and interquartile range, complemented with the mean and standard deviation. The variables, age group, PAL and medication use, were presented in absolute and relative frequencies. Non-parametric tests were conducted, as it was not possible to assume the normality of the distributions followed by the variables, both in the general population, by sex and age group. Intergroup differences in continuous variables were studied using the Mann–Whitney U test. The chi-square test, effect sizes reported by the contingency coefficient (CC), and the z-test were used to analyse intergroup differences of ordinal variables. Spearman's rho was calculated for analysis of the correlation between variables, being interpreted according to Mondragón's proposal (0.01 to 0.10 is considered a weak positive correlation, 0.11 to 0.50 a medium positive correlation, 0.51 to 0.75 a strong positive correlation, 0.76 to 0.90 a very strong positive correlation and 0.91 to 1.00 a perfect positive correlation) [27]. A multiple binary logistic model was used to study effects of predictor variables (age, sex, social class and PAL) on medication use. Two-sided p-values ≤ 0.05 were considered statistically significant. The results were presented by distinguishing the sex of the participants.

3. Results

No significant differences were found between men and women in the median ages (p = 0.467), nor were dependency relationships found between sex and age group

($p = 0.227$). Medication use showed a dependency relationship with the sex of the participants ($p < 0.001$. CC = 0.096), as well as significant differences between the population proportions of males and females who reported having used and/or not having used medication ($p < 0.05$). A difference of 9.6 percentage points was found between the proportions of male (46.6%) and female (56.2%) medication use. A total of 51.6% of the general population reported having used medication (Table 2).

Table 2. Socio-demographic characteristics, use of medicines in the last two weeks, use and number of visits to emergency services in the last year, and level of physical activity of the Spanish population in 2017.

Variables				
Age (Years)	Overall = 17,199	Men = 8238	Women = 8961	*p*-value Mann-Whitney U test
Median (IQR) Mean (SD)	47 (21) 46.8 (13.2)	47 (20) 46.7 (13.2)	47 (21) 46.9 (13.3)	0.467 -
Age groups (Years)	Overall n (%)	Men n (%)	Women n (%)	*p*-value chi-square test
18–34	3316 (19.3)	1573 (19.1)	1743 (19.5)	
35–49	6195 (36.0)	3007 (36.5)	3188 (35.6)	
50–64	5977 (34.8)	2874 (34.9)	3103 (34.6)	0.227
65–69	1711 (9.9)	784 (9.5)	927 (10.3)	
Use of medicines	Overall = 17,199 n (%)	Men = 8238 n (%)	Women = 8961 n (%)	
Yes	8878 (51.6)	3838 (46.6)	5040 (56.2) *	<0.001
No	8321 (48.4)	4400 (53.4)	3921 (43.8) *	
PAL	Overall = 17,141 n (%)	Men = 8199 n (%)	Women = 8942 n (%)	
Inactive (PAI = 0)	2482 (14.5)	1156 (14.1)	1326 (14.8)	
Walker (PAI = 0)	7901 (46.1)	3335 (40.7)	4566 (51.1)	
Low (PAI = 1–15)	2339 (13.6)	1077 (13.1)	1262 (14.1)	
Medium PAI = 16–30)	2349 (13.7)	1273 (15.5)	1076 (12.0)	<0.001
High (PAI = 31–45)	1353 (7.9)	877 (10.7)	476 (5.3)	
Very high (PAI = +45)	717 (4.2)	481 (5.9)	236 (2.6)	

IQR (interquartile range); SD (standard deviation); n (participants); % (percentage); PAL (physical activity level); PAI (physical activity level. Scores: 0–67.5); Inactive (PAI = 0; reported not going for a walk for more than 10 min at a time on any day of the week). Walker (PAI = 0; reported going for a walk for more than 10 min at a time on any day of the week); * (Significant differences between sex ratios, $p < 0.05$ from z-test).

A dependency relationship was observed between PAL and sex ($p < 0.001$). A total of 54.8% of men and 65.9% of women did not perform moderate and/or vigorous PA (low, medium, high, or very high PA), with a gender gap of 11.1 percentage points (Table 2).

A dependency relationship between medication use and age group was found in both the general population and in both sexes ($p < 0.001$. Overall: CC = 0.324; Men: CC = 0.361; Women: CC = 0.291). The proportions of people using medication increased with increasing age ($p < 0.05$). The proportions of people who used medication in the two weeks before the survey increased from 31.1% in young people to 84.6% in older people. In men, these proportions increased from 22.3% in young people to 82.8% in older people, compared to 39.1% and 86.1%, respectively, in women (Table 3).

Table 3. Relationship between medicine use and age group in the general 18–69 years old Spanish population in ENSE2017 and stratified by sex.

		Age Groups: n (%)				
Sex	**Use of Medicines**	**18–34 Years**	**35–49 Years**	**50–64 Years**	**65–69 Years**	***p***
Men (n = 8238)	Yes (46.6%) No (53.4%)	350 (22.3) a 1223 (77.7) a	1056 (35.1) b 1951 (64.9) b	1783 (62.0) c 1091 (38.0) c	649 (82.8) d 135 (17.2) d	<0.001
Women (n = 8961)	Yes (56.2%) No (43.8%)	681 (39.1) a 1062 (60.9) a	1472 (46.2) b 1716 (53.8) b	2089 (67.3) c 1014 (32.7) c	798 (86.1) d 129 (13.9) d	<0.001
Overall (n = 17,199)	Yes (51.6%) No (48.4%)	1031 (31.1) a 2285 (68.9) a	2528 (40.8) b 3667 (59.2) b	3872 (64.8) c 2105 (35.2) c	1447 (84.6) d 264 (15.4) d	<0.001

n (Participants); % (Percentage); a–d (Each lowercase letter denotes a subset age group whose proportions of use of medicines do not differ significantly from each other with $p < 0.05$ from z-test); p (p-value from chi-square test).

Medication use and PAL showed a dependency relationship ($p < 0.001$), both in the general population (CC = 0.150) and by sex (men: CC = 0.185; women: CC = 0.095), as well as by age group (Table S1, Supplementary Material). In 18–34 years, there was a difference of more than 12 points in the prevalence of medication use between "Inactive/Walkers" (35.2% and 35.7%, respectively) and "High" PA level (22.7%). These differences in proportions were even greater in the remaining age groups, finding the highest prevalence of medication use in "Inactive/Walkers", and the least in "High" PAL. On the other hand, in the older group (65–69 years), the group with a "Very high" PA level was the one with the lowest proportion of medication use (60.7%), by 87.5% in "Inactive" (Figure 1).

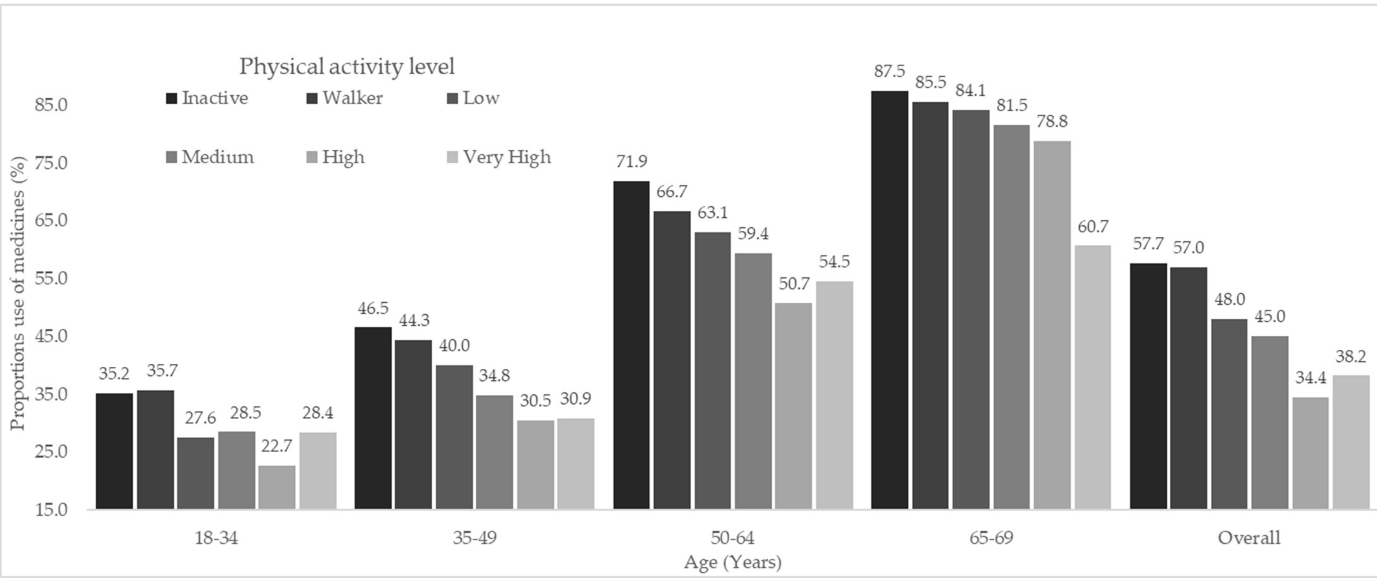

Figure 1. Use of medicines, according to physical activity level by age group.

Regarding the classification by sex, women have a very similar relationship to the general population; except for women aged 18-34 years, who do not show differences in proportions of medicine use, according to the PAL. Men coincide in terms of taking medicines and segregation by age group, but a more specific analysis shows that for the 18–34 and 50+ age groups, the "Inactive" take medicines in a higher percentage. For the 35–49 age group, it is those who perform "Walking" PA who take the highest proportion of medicines compared to the other PA levels. On the other hand, the lowest percentages of medicine intake are found among those who perform "Very high" PA, apart from the youngest age group, which corresponds to "High" PA. Irrespective of sex, the greatest differences in the use of medicines are found in the 65–69 age group, with a percentage difference of 29.6 points in women and 24.4 points in men (Table S1, Relationship between the level of physical activity and medicine use by age group in the general Spanish population of ENSE2017: 18–69 years and by sex).

Weak correlations were found (Table 4), statistically significant, between PA index (rho = −0.138, $p < 0.001$); and between PAL (rho = −0.149, $p < 0.001$); and medication use. In men: rho: −0.178, $p < 0.001$ (PAI) and rho: −0.189, $p < 0.001$ (PAL). In women: rho = −0.088, $p < 0.001$ (PAI) and rho: −0.089, $p < 0.001$ (PAL).

Table 4. Correlation between level of PA and use of medicines.

Variable	Physical Activity Level					
	Women		Men		Overall	
	Rho	*p*	Rho	*p*	Rho	*p*
Use of medicine	−0.089	<0.001	−0.178	<0.001	−0.149	<0.001

Rho (Spearman's rho coefficient); *p* (*p*-value).

According to the results of the multiple binary logistic regression analysis on the use of medications, the elderly, women, and people with a low physical activity level and low social class showed a higher risk of using medications (Table S2, Supplementary Materials). The model explained 18.0% (Nagelkerke's R2) of the variance of medication use.

4. Discussion

The main finding of this study was the dependency relationship found in the Spanish population between PAL and medication use, as has been demonstrated by various studies in other countries and populations [28–30]. Our evidence mainly reports that medication use may decrease as PAL increases, especially when moderate and/or vigorous activities are included, as indicated by similar results in other studies [6,8].

According to the data obtained in this study, it is novel to be able to classify medication use by three variables: sex, age and PA.

The present study shows the prevalence of medicine use in the general Spanish population, reaching a percentage of more than half of the population, in the age range 18–69 years. In terms of sex, the proportions taking medication were higher in women than in men in Spain, representing a gender gap of 9.6 percentage points. In a similar study on the Italian population, a dependency relationship between sex and medication use was also found. As in our research, the results reported that men tend to consume less medication than women [31].

Concerning age, higher proportions of medication use were found in each of the older age groups, as in a similar study [32]. In the general population, the proportion of people taking medication increased significantly in young people, and even tripled in older adults. Young women and older women also had higher proportions of medication use than younger and older age groups, compared to the same age groups of men. The fact that there is a gender difference in the use of medicines in younger groups (greater in women) and that this is reduced with increasing age has also been demonstrated by a previous study, whose results are similar to ours [32].

On the other hand, this study also found a dependency relationship between PA and medicine consumption, both in the general population and by gender and age group, in line with findings found in other studies [6,8]. Increasing PAL, including moderate and/or vigorous PA, appeared to reduce the prevalence of medication intake in the population that practised it, concerning the "Inactive" and "Walking" groups. These findings have also been addressed in other studies that have found decreases in health care medicine costs by increasing PA in the general population, and in people with diabetes or other pathologies [7,33]. Similarly to our results, other authors proposed to adjust the amount of PA according to the lifestyle habits of today's societies, with small [34], or very small amounts of exercise [35]. Although walking may slightly reduce the prevalence of medication use in young and older adults, it does not seem to be an effective dose for this, so higher intensities are required. However, within the relationship between physical activity and use of medicines, there are some determining variables that must be taken into account: wealth and the built environment. It has been shown in previous studies that the economic social class to which one belongs influences the amount of physical activity of the population and thus the use of medicines [36–39]. In line with the above-mentioned research, according to the analysis conducted in this study, the lower and middle social classes are less physically active and consequently have a higher risk of consuming more medicines than the upper social classes.

Based on the above, it is considered important to promote programmes that encourage the increase of PA in the general population to high levels. In this way, it would be possible to achieve a significant reduction in the proportion of people using medication, thereby reducing the health expenditure involved. Increasing PAL in the population appears to reduce medication use in both sexes and at all ages, but especially in the elderly, where a very high PAL may be associated with a substantial reduction in the prevalence of medication use in the population. This scientific evidence is also corroborated by a study similar to ours [40], indicating that the annual expenditure on medicines in the elderly was higher and inversely associated with the level of physical activity and walking engagement, i.e., the higher the PAL, the lower the medicine use [40]. In this sense, an increase in PAL in the elderly would be advisable to reduce medication use, although always avoiding a disproportionate increase, and should be supervised by a multidisciplinary team of health and PA professionals, to follow the appropriate recommendations [41].

Regarding correlations, there is sufficient evidence in the literature showing that PA can be seen as a vaccine that prevents chronic diseases and premature deaths, thus reducing the health expenditure devoted to their treatment [4,42–44]. However, the correlations in this study are lower than expected due to the use of microdata from the National Health Survey, and therefore other variables that could explain the low correlation are unknown.

The present study must be understood with certain limitations in mind, to achieve a logical interpretation of the results. Given that a non-longitudinal design was used, and that the data were obtained from a National Health Survey, without a specific research objective, it is not possible to provide a complete answer to these results. Also, the clinical information was self-reported and incomplete (no knowledge of risk factors, no reported clinical history), which invites us to take the data with caution. In addition, another limitation is the possible contaminating biases that have not been taken into account in the current research and that should be complemented in future research, such as the analysis of possibly determining socio-demographic variables: level of education and marital status of the participants or the inclusion of non-binary groups. Nevertheless, the baseline results are in line with other previous studies, and for the ratings and relationships obtained, it is suggested to investigate the efficacy of PA levels for medication use.

Regarding future lines of research, this study provides a frame of reference with pre-pandemic data, as analyses were conducted with the last DHS before the COVID-19 pandemic. The findings of this study will allow for comparative analyses with post-pandemic periods, once the data from the next DHS are published in 2023, or with other health surveys from different countries. In future NSSEs, it would be advisable for the MSCBS to include objective PA data, incorporating low-cost inertial devices to assess participants' PA, as well as other objective markers of health, as included in other national health surveys in other countries.

Overall, to reduce the use of medication in the population, we suggest following the recommendations postulated by international organisations. Thus, the WHO states that vigorous and/or moderate PA, between 75 and 150 min per week, respectively, or an equivalent for a healthy and active life, would be recommended [45–47].

5. Conclusions

Based on the results, PAL is associated with the use of medicines in the Spanish population aged from 18 to 69 years. Specifically, higher PAL meant a lower proportion of people using medicines in the Spanish population, independently of sex and age group. Therefore, increasing PAL, including moderate and/or vigorous activities, might decrease health expenditure by reducing the use of medicines. More research is needed to corroborate these findings and achieve optimal dose-responses for each population group.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su142013615/s1, Table S1: Relationship between the level of physical activity and medicine use by age group in the general Spanish population of ENSE2017: 18–69 years and by sex. Table S2. Logarithmic binary regression model for use of medication risk factor.

Author Contributions: Conceptualization, Á.D.-Z. and J.C.A.-S.; data curation, Á.D.-Z. and J.C.-V.; formal analysis, Á.D.-Z. and J.C.-V.; funding acquisition, M.Á.G.-G. and J.C.A.-S.; investigation, Á.D.-Z.; methodology, Á.D.-Z.; project administration, R.P.-C. and A.C.-M.; resources, M.Á.G.-G. and N.C.-B.; software, Á.D.-Z. and J.C.A.-S.; supervision, R.P.-C. and A.C.-M.; validation, N.C.-B. and A.C.-M.; visualization, N.C.-B.; writing—original draft, Á.D.-Z.; writing—review and editing, M.Á.G.-G., R.P.-C. and J.C.A.-S. All authors have read and agreed to the published version of the manuscript.

Funding: The author Á.D.-Z. (FPU20/04201) was supported by a grant from the Spanish Ministry of Education, Culture and Sport Grants FPU/04201 funded by MCIN/AEI/10.13039/501100011033 and, as appropriate, by "European Social Fund Investing in your future" or by the "European Union NextGenerationEU/PRTR".

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The microdata were obtained on: https://www.sanidad.gob.es/estadisticas/microdatos.do (accessed on 12 February 2022).

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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