The level of physical activity affects the health of older adults despite being active

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INTRODUCTION

Ageing represents a fundamental problem for society due to the demographics changes in the older population, which is increasing with the ages, and also to an increase in the dependency taxes. These facts suggest new perceptions around the older population, like the socioeconomic and sanitary environment (Abades Porcel and Rayón Valpuesta, 2012). Societies have to improve the robustness of health, long-term care, and welfare systems in Europe, and to help people to be healthy and active in their older ages (Rechel et al., 2013). The predictions for 2050 are that there will be 16 millions of older adults around the world, which correspond to 30% of the total population. Currently, older adults represent about 19% of the total population in Spain, though this population is increasing faster than the older population in other European countries. Life expectancy has increased markedly in older adults between 65 to 85 yr during this century, thus contributing to the global ageing community.

The physical, economic and social environments are changing the daily living patterns of humans and this includes the demands of physical activity (PA) (Owen et al., 2010). Among older populations the concept of healthy ageing has developed. This concept includes issues like the person's social life and economic security. Home surroundings plays a role in developing and supporting personal strategies for healthy ageing (Sixsmith et al., 2014). In recent studies, PA is associated with better physical health and is a priority of public health with a successful ageing population (Giglio et al., 2015; Moreno et al., 2014). Physical function...
and PA are described as a consequence of well-being, which seems especially important for older people. The importance of PA influences the physical health and functional status, as well as the life satisfaction, the life appraisal and the “age well” perceptions of older adults. The positive psychological effects of PA in disabled subjects is emphasized (Garatachea et al., 2009).

Studies have demonstrated that PA should be especially recommended for the promotion and maintenance of better health and functional ability in older adults, this being a major public health concern. This is due to the increasing life expectancy and that the prevalence of disease rises with age (Giné-Garriga et al., 2014; Rechel et al., 2013; Stephan et al., 2011; Vallance et al., 2012; Withall et al., 2014).

Evidence demonstrates that PA programs in the older community can minimize the effect of diminishing strength and give an improvement in functional ability (Giné-Garriga et al., 2014; Quehenberger et al., 2014). Mobility is also a major problem for older adults because limited mobility can seriously decrease their quality of life (QoL). Quehenberger et al. (2014) and Salguero et al. (2011) suggested that PA can show a benefit in the mental perception as measured with the QoL and also shows a positive impact on depression. These authors have shown that an increase in the amount of PA taken is positively related to a significant improvement in the depressive status. Along the same lines, the recent literature (Hamer et al., 2014; Hupin et al., 2015; Jeoung, 2015; Ofei-Dodoo et al., 2016) shows that older adults have exponential health benefits and longevity as PA increases, whether or not they were considered active, until their activity level reached about ten times the international recommendation (Arem et al., 2015).

Nevertheless, while many studies have focused on the sedentary older adult population, there is a lack of information in the literature regarding specific findings about the association between amounts of PA during daily life activity and important health variables in those older adults considered to be “active” (Nelson et al., 2007), as balance in functional activities and depression symptoms.

To our knowledge, this study is the first to compare varying amounts of PA with health indicators in two active elderly community. Our hypothesis is that higher amounts of PA in the older adult population will correlate with improvements in functionality and balance scores. The secondary objective is to determine the association between depressive symptoms and perceived QoL between groups.

MATERIALS AND METHODS

Study design

This study is a cross-sectional study where we collected data about the relationships among PA and health variables in an active older population attending a dwelling-based community programme in Madrid (Spain), for a fixed time period of three months. This specific community attend 2 times per week to develop PA sessions and the rest of the week had very different amounts of PA. Anonymity was not necessary during the monitoring of the study and only the investigator who did the statistical analysis was ‘blind’. All of the procedures used in this study were planned under the ethical norms of the Helsinki Declaration and were approved by the local ethics committee of the Centre for Advanced Studies University La Salle, (CSEULS-PI-046/2015). This study follows the “Strengthening the Reporting of Observational Studies in Epidemiology” (STROBE statement) (von Elm et al., 2008).

Recruitment of participants

Participants had the following inclusion criteria: men and women ranging in age from 65 to 80 yr, attending to different active older community, with capacity for walking for at least three minutes without help, with maintained cognitive functions, being able to read, write and understand the Spanish questionnaires. On the other hand, the exclusion criteria were: subjects with some incapacity, those hospitalized or with a dependency. Subjects with any cognitive pathology such as dementia, terminal illness and relevant clinical records which may stop PA were also excluded. Participants were collected in three dwelling communities in Madrid where they go every day to participate in different physical activities. The participants completed the questionnaires in a private room in these same locations, under the supervision of the investigator.

Procedure

This protocol was performed by an evaluator who had not participated in the selection and data collection procedures, to ensure the ‘blinding’ status of the investigation. After consenting to the study, the recruited patients were given a set of questionnaires to complete on the day of the evaluation. All the measures were acquired on the same day, during an hour with each participant. All questionnaires were coded with an identification number rather than a name to blind this data to the other investigators. These included various self-reports for the identification of the PA level,
QoL and depression symptoms. Finally, a test to determine the functionality of the participant was conducted.

All participants in this study were active enough to be considered ‘active,’ previously characterized in the literature as participating in moderate- to vigorous-intensity PA for at least 150 min per week (Nelson et al., 2007) for older adults without chronic conditions. At present, no cutoff value is defined for active older adults; however, comparing groups with differing amounts of PA could yield important data about how activity affects various health conditions. Therefore, according to the Spanish version of the Yale Physical Activity Survey (YPAS) summary index distribution, the sample was divided into a more activity (MA) and a less activity (LA) group along the median, as described elsewhere (Salpakoski et al., 2011).

Outcomes measures

To evaluate the QoL parameter we used the questionnaire Euro-QoL (EuroQol five dimensions questionnaire, EQ-5D). This questionnaire, which has been validated to Spanish (Herdman et al., 2001), consists of two phases and a visual analogue scale (VAS), which measure the QoL in both healthy and sick people. The patient state of health is evaluated in five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has three levels: no problems, some problems, and severe problems, where the patient has to mark in the box the most appropriate item in each dimension. Each level has a quantitative number 1 to 3 but the patient does not know the meaning (Pradas Velasco et al., 2009). A unique health state is produced as a result of combining one level from each of the five dimensions and then calculating a final EQ-5D index. A total of 243 possible health states are defined in this way. Each state is referred to in terms of a 5-digit code. For example, state 11111 indicates no problems in any of the five dimensions. After that the patient again evaluates his/her health in the VAS, a numeric scale extending to 20 cm, where the endpoints are labelled ‘Best imaginable health state’ and ‘Worst imaginable health state’ and its high score is 100 points and fall (minimum) score is 0 points. This information can be used as a quantitative measure of health outcome as judged by the individual respondents. The advantages of this questionnaire are that it is short, easy to complete and simple to understand. Furthermore, its administration is rapid, the patient can fill out the questionnaire in 2–3 min (Herdman et al., 2001).

The balance and functional capacity were measured by the Berg balance scale (BBS) which is validated to Spanish (Berg et al., 1992). The BBS is an evaluation tool used to identify the balance capacity during the functionality activities. This scale includes 14 items each with a score ranging from 0 to 4, which are combined to get a final score ranging between 0 (balance is seriously affected) and 56 (excellent balance). These scores will be low if the participant cannot complete the task or has to complete the task with help. The participants must be able to complete the 14 tasks while the examiner evaluates the capacity of each participant in each task. The results were classified into three simpler groups: high risk (0–20), moderate risk (21–40), and low risk (41–56). The investigator demonstrated each task before assessing the participant who replicated it.

The depression level was measured in the subjects by the geriatric depression scale (GDS), which is validated to Spanish (Ramos Brieva et al., 1991) and is an easy questionnaire to fill out. In the study, we used the short form of the GDS with 15 questions. Ten of the 15 questions indicate the level of depression when the participant answers affirmative while the rest of the questions indicated depression when the participants answer negatively. Scores of 0–4 are considered normal; 5–8 indicate mild depression; 9–11 indicate moderate depression; and 12–15 indicate severe depression.

Finally, to measure the level of the subjects’ PA and classify them in two groups we used the Spanish version of the YPAS (Katz et al., 2014). The YPAS determines the type and amount of PA and is based on a questionnaire designed for older adults and provides an index for a typical week during the last month. This also provides information on whether activities are light, moderate or high intensity. The activity dimensions summary index (total units) was computed by estimating the number of hours spent in five PA dimensions (vigorous activity, leisurely walking, moving, standing, and sitting), multiplying it by frequency, and multiplying it again by a weighing factor.

Sample size

The sample size was estimated with G*Power 3.1.7 for Windows (G*Power from University of Dusseldorf, Dusseldorf, Germany) (Faul et al., 2007). It was considered a power calculation to detect between-group differences in the BBS. An independent samples Student t-test analysis was used to detect mean difference between groups (the MA and LA groups) because it was the main factor of interest. This used an effect-size of 0.65 (medium) based on a pilot study with a sample of 17 subjects (eight from the MA group and nine from the LA group). A medium effect size of 0.79 was used to obtain 90% statistical power (1-β error probability) with an α error level probability of 0.05 suggested a sample size.
of 58 participants (29 per group).

**Statistical analysis**

All data analyses were performed on IBM SPSS Statistics ver. 21.0 (IBM Co., Armonk, NY, USA). The statistical analyses were conducted at a 95% confidence level and a P-value less than 0.05 was considered statistically significant. Descriptive statistics include means and standard deviations.

A normal distribution of the data was confirmed with the Kolmogorov-Smirnoff test. For comparison of the outcomes between the two groups a Student t-test for independent samples was used. Effect-sizes (Cohen d) were calculated for the outcome variables. According to Cohen method, the magnitude of the effect was classified as small (0.20 to 0.49), medium (0.50 to 0.79), or large (≥0.8) (Cohen, 1988).

The relationship between PA, functionality, depressive symptoms and state of health was examined using Pearson correlation coefficients. A Pearson correlation coefficient greater than 0.60 indicated a strong correlation, a coefficient between 0.30 and 0.60 indicated a moderate correlation, and a coefficient below 0.30 indicated a low or very low correlation (Hinkle et al., 1988).

**RESULTS**

We measured a total of 64 subjects without missing values. When the sample was divided in two groups with half of the subjects in each group, the LA group had 62% of females and the MA group 50% respectively. All the other characteristics of subjects are shown in the Table 1.

Results of the Student t-test for equality of media in the independent samples test demonstrated a significant PA factor for the BBS between groups (t = 2.21, P = 0.03, d = 0.27). There were no statistically significant differences between all the other variables.

The Pearson correlation analysis shows in LA group a moderate correlation within the BBS and other variables as age (r = -0.539, P < 0.01), EQ-5D VAS (r = -0.480, P < 0.01), EQ-5D time trade-off (TTO) (r = 0.385, P = 0.03), and Vigorous Exercise (r = 0.383, P = 0.03).

Moreover, both groups had a moderate negative correlation between GDS and the the EQ-5D TTO (r = -0.543, P = 0.02). A higher depression index is in line with lower QoL. All the results are presented in Table 2.

**Table 1.** Summary of demographic variables and comparison between groups with Student t-test.

| Characteristic | MA group (n=32) | LA group (n=32) | t | Mean difference (95% CI) | Effect size |
|---------------|----------------|----------------|---|--------------------------|------------|
| Age (yr)      | Mean ± SD      | Range          | Mean ± SD      | Range          |            |
| QoL VAS       | 69 ± 3.46      | 65–78          | 72 ± 6.38      | 65–88          | 2.29       | 2.94 (0.37 to 5.50)**       | 0.27       |
| EQ5D TTO      | 0.80 ± 0.15    | 0.42–1.00      | 0.78 ± 0.22    | 0.256–1.100    | -1.69      | -5.56 (-12.13 to 1.00)    | -0.21      |
| EQ5D VAS      | 0.81 ± 0.15    | 0.51–1.00      | 0.75 ± 0.19    | 0.379–1.100    | -1.58      | 0.07 (.15 to .18)          | 0.17       |
| GDS           | 1.84 ± 1.97    | 0–8           | 2.56 ± 2.38    | 0–7            | -1.02      | -0.85 (0.18 to 0.01)      | 0.21       |
| BBS           | 52.28 ± 3.77   | 44–56          | 48.88 ± 7.83   | 24–56          | -2.22      | -3.41 (-6.48 to -0.34)*    | 0.27       |
| YPAS          | 195.37 ± 100.94| 108–602        | 70.50 ± 26.59  | 13–105         | -6.77      | -124.87 (-161.76 to -87.99)** | 0.65       |

*The mean difference is significant at the 0.05 level. **The mean difference is significant at the 0.01 level.

**Table 2.** Pearson correlations coefficient between the different variables analyzed in the study.

| Variable | Age | QoL VAS | EQ5D TTO | EQ5D VAS | Group |
|----------|-----|---------|----------|----------|-------|
| QoL VAS  | -0.131 | -      | -        | -        | LA    |
|          | -0.094 | -      | -        | -        | MA    |
| EQ5D TTO | -0.224 | -0.049 | -        | -        | LA    |
|          | -0.063 | 0.048  | -        | -        | MA    |
| EQ5D VAS | -0.235 | 0.040  | 0.956**  | -        | LA    |
|          | -0.115 | 0.135  | 0.929**  | -        | MA    |
| GDS      | 0.278  | -0.369*| -0.401*  | -0.442*  | LA    |
|          | -0.021 | -0.330 | -0.543** | -0.566** | MA    |
| BBS      | -0.539**| -0.067 | 0.385*   | 0.480**  | LA    |
|          | -0.258 | 0.282  | 0.314    | 0.386*   | MA    |
| YPAS     | -0.373*| 0.072  | 0.177    | 0.116    | LA    |
|          | -0.280 | 0.332  | -0.265   | -0.288   | MA    |

QoL VAS, quality of life perceived in visual analogic scale; EQ5D, EuroQol five dimensions questionnaire; EQ5D TTO, quality of life score, EQ5D time trade-off; EQ5D VAS, quality of life VAS score; MA, more activity; LA, less activity; GDS, geriatric depression scale; BBS, Berg balance scale; YPAS, Yale Physical Activity Survey, final index of physical activity per week.

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DISCUSSION

The purpose of this study is to investigate two groups of active older adults who engage in different amounts of PA. The relationship between PA and functional capacity, QoL, and depression will be discussed.

Similar studies in the adult older population used sedentary and active segmentation of the sample analyzed to describe the grade of PA. However, we used LA and MA groups because, in our study, all the participants took part in a sufficient quantity of PA (Nelson et al., 2007).

Statistically significant differences in the balance and functional capacity of the two groups of active older adults were found. Older adults allocated to the MA group had better BBS scores. Recent literature has shown a medium risk of falling with similar mean values for the BBS in this population (Allison et al., 2013) while other authors suggested that cutoff points below 49 and 50 (Riddle and Stratford, 1999; Shumway-Cook et al., 1997; Yümin et al., 2011) indicate the patient is 3 times more likely to suffer a fall. However, this scale has been found to be more sensitive in inactive older adults (Santos et al., 2011). This data matched with our results of both groups of active elderly, where the LA group mean score is less than 49 and the MA group is greater than 52 points. Moreover, in a recent intervention study involving an elderly population with BBS scores similar to our LA group, participating in a 6-week program achieved an improvement that was comparable to our MA group (Cakar et al., 2010).

When the sample is analysed within groups, the LA group showed several relationships among the BBS and different measured variables, linked to the level of physical functionality in daily life activity and participants’ static and dynamic balance abilities. In our study there was a significant observation when the participants get older in this group, there was an association with this functional scale, which may predict a higher risk of falls, as seen in previous studies in the literature where the PA declines with increasing age (Fone and Lundgren-Lindquist, 2003). This data indicates a lower functionality in daily life activity that was very well studied previously, where neuromuscular function seems to be a critical factor for maintaining muscle strength and physical independence (Tanimoto et al., 2012). These results were also in line with findings showing links between brain atrophy and multidimensional physical functioning in older adults where muscle strength, balance and exercise capacity were related to brain volume changes in the medial temporal lobe (Makizako et al., 2011) and a reduced cell loss in sensitive areas like the hippocampus, which may play a decisive role in successful everyday functioning (Colcombe et al., 2003).

Also we have found lower QoL when the BBS variable shows a lower score. Despite the lack of knowledge about the relationship with the type of physical activities on the QoL, some studies in the literature regarding the ageing population often shows similar results with poor functional capacity in their ability to perform daily tasks when this variable is decreased (Motl and McAuley, 2010; Neto et al., 2015). This was also noted in previous studies where declining functionality is associated with changes in hormone levels, with an increase in cortisol blood levels (Mura et al., 2014a).

In our analysis of this group with LA, the type of PA was also statistically associated with this variable, where those with less vigorous activity reported poorer functionality. This issue was also found by Mura et al. (2014b) in an elderly community where they observed that the intervention group with vigorous activity maintained significantly-higher scores of QoL compared with other groups that achieved lower intensity rates. This QoL is frequently studied in this population (Neto et al., 2015) and in our study is associated with lower depression index. In the same manner as our findings, Rodrigues et al. (2015) provided evidence in their study that depression is very prevalent in this population and has a greater impact on QoL than other important comorbidities. Recent studies also found important concerns about the QoL in the older adults population, which is mainly impaired by depression (Unützer, 2009) and is also related to the PA function and general health perceptions (Saarijärvi et al., 2002).

In recent years, several multitude clinical trials (Du et al., 2015; Jeoung, 2014; Lincoln et al., 2011; Pereira et al., 2013; Yoshida et al., 2015) and a systematic review (Cho, 2014) where depression index is being approach have been carried out with very good results associated with special PA programs for the elderly community. This is an important issue to both establish better treatments and a reduction of costs in the public health system (Luber et al., 2001). Therefore, prevention strategies with this type of intervention should be a priority (Rovio et al., 2005).

In conclusion, active older adults with different amounts of PA differ in their BBS score. This functional score was higher in the MA group. With regards to QoL, only the LA group was negatively associated with age while in both groups showed a negative association with the depression index.

Our study has some limitations; first the number of women was relatively higher than men. Second, our sample was enrolled in an
activity programme and the results may not be comparable with other ageing populations with more sedentary lifestyles. Finally, we consider that an important limitation in this study is that no anthropometric variables were measured, as these could influence the levels of PA. Future studies should investigate the relationship between functionality, QoL, PA levels with anthropometric variables.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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