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The influence of winter and summer seasons on physical fitness in aged population

P. Bezerra[a,b,*], Luis P. Rodrigues[a,b], C. Ayan[c,d], J.M. Cancela[c,d]

[a] Instituto Politécnico de Viana do Castelo, Portugal
[b] Sports Sciences, Health Sciences and Human Development (CIDESD), Portugal
[c] HealthyFit Research Group, Spain
[d] Faculty of Education and Sport Sciences, University of Vigo, Spain

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ABSTRACT

Epidemiological studies have described the association between physical fitness and health. Few have reported the impact of seasonal variation on fitness determinants, in elderly. We investigated the effects of summer and winter environmental conditions on physical fitness, in both exercise and non-exercise elders. 371 non-institutionalized older adults (74.1% female; 78.4 ± 5.3 years) randomly recruited from a total sample of 1338 subjects from north of Portugal, were prospectively followed during 1 year and 3 assessments were performed – April (baseline), October (summer season) and April (winter season). Four groups were defined, according to reported habits of exercising: Exercise (EG); Winter Exercise (WG); and Summer Exercise (SG); non-Exercise (nEG). Muscle strength was assessed with handgrip and isometric knee extension test, and aerobic capacity with the 6 min walking test. Repeated measures ANOVA with two between-subjects factors were run for independent variables, considering a three Time points. Significance set at $p < .05$. Findings show that: (1) men were fitter than women; (2) EG showed better results than nEG ($p = .000$), but not different than WG or SG, (3) nEG physical fitness was not significantly different from WG and SG; (4) SG and WG showed similar results; (5) there was significant group-by-time interaction for all variables in study. Among elderly, the regular physical exercise determined better cardiorespiratory fitness and levels of strength compared to individuals that were not exercising, however, no season impact was observed. Independently of exercising mode, regular, seasonal or not exercising, the pattern of changes in physical fitness throughout the year was similar.

1. Introduction

The age-related decline in physical fitness in aged population is well reported in literature (Ribom, Mellstrom, Ljunggren, & Karlsson, 2011; Rikli & Jones, 2013). By the fifth decade, similarly to the muscle mass decline, the losing in muscle strength occurs at steady decline rates of approximately 1–2% per year (Vandervoort, 2002). The deterioration on physical fitness seems to contribute to rising morbidity and mortality rates (Paterson & Warburton, 2010).

Previous longitudinal studies have reported the effectiveness of the intervention programs in maintaining quality of life (Blain et al., 2012). For example, exercise intervention programs applying to muscle strength (Geirsdottir et al., 2012; Seguin, Heidkamp-Young, Kuder, & Nelson, 2012), aerobic training (Halloway, Wilbur, Schoeny, Semanik, & Marquez, 2015), or both (Cadore et al., 2014), have been reported as successful contributors for improving physical fitness. Furthermore, intervention programs including different exercise type as Tai Chi (Callahan, Cleveland, Altpeter, & Hackney, 2015) or Pilates (Geremia, Iskiewicz, Marschner, Lehnen, & Lehnen, 2015), have shown important and positive output on the physical fitness of aged population, comparatively to their not exercising counterparts.

Daily conditions were find to modify customary physical activity and daily routines (Kristal-Boneh, Froom, Harari, Malik, & Ribak, 2000; Merrill, Shields, White, & Druce, 2005). Results show that elderly took a higher amount of steps in summer comparatively to winter season (Clemes, Hamilton, & Griffiths, 2011), and that levels of physical activity vary with seasonality, being the poor or extreme weather a barrier to participation in physical activity with a possible negative impact physical fitness (Tucker & Gilliland, 2007). In fact, little is known about the impact of winter and summer seasonal variations conditions in physical fitness of aged population (Clemes et al., 2011; McCormack, Friedenreich, Shiell, Giles-Corti, & Doyle-Baker, 2010). Therefore, the aim of this study was to investigate the effects of summer and winter seasonal conditions on the physical fitness in both, exercise and non-

* Corresponding author at: Escola Superior Desporto e Lazer, Complexo Desportivo e Lazer, Comendador Rui Solheiro, Monte de Prado, 4960 320 Melgaço, Portugal.
E-mail address: pbezerra@esdl.ipvc.pt (P. Bezerra).

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exercise aged population.

2. Methods

This study was a 12 months longitudinal design involving aged population. Three testing sessions were defined as baseline, month 6 and month 12, according to two-time series: summer period, from May to October, and winter period from November to April. During these periods the median air temperatures registered in Portugal were 20.5 °C for summer, and 11.3 °C for winter. Rainfall values were 11.3 and 115.1 mm respectively for summer and winter periods. All participants were tested in the same daily period, from 10.00 to 12.00 h.

2.1. Sample

371 volunteers with 70 years old and over were recruited from Alto-Minho, Portugal aged population (74.1% female; aged 78.4 ± 5.3 years; height, 1.54 ± 0.09 m; weight, 70.2 ± 12.9 kg; BMI, 29.4 ± 4.5, at baseline). The sample size was determined by a priori estimation based on the effect size of 0.8, power of 0.95 and alpha level of 05, using the G" Power 3 program (version 3.0.3; Dusseldorf, Germany; Faul, Erdfelder, Lang, & Buchner, 2007), in an attempt to minimize type I and type II errors. The inclusion criteria of recruitment was presently healthy as screened by a family physician. The exclusion criteria were (a) lack of independent ambulation, (b) recent lower limb injuries, (c) neurologic or lower extremity orthopedic diagnoses, (d) corrected visual acuity worse than 20/100 or presence of a field defect, (e) acute illness.

Four groups were defined according to participants exercising practice level (see Fig. 1), named physical activity level (PA): Exercise Group (EG) exercised at least two times a week (n = 125); non Exercise Group (nEG) does not exercise or exercises less than two times a week (n = 141); Summer Group (SG) exercises at least two times a week in summer season but does not exercise or exercises less than two times a week in winter season (n = 57); Winter Group (WG) exercises at least two times a week in winter season but does not exercise or exercises less than two times a week in summer season (n = 48). Exercising type and intensity was not controlled by research. To participants were asked about exercising vs not exercising, number of sessions by week and period of year exercising. According to inquiry, participants were allocated to the groups. Informed consent was obtained from all participants and approval for the experimental procedures was obtained from the Scientific Council of Polytechnic Institute of Viana do Castelo.

2.2. Testing

Anthropometric variables body weight was measured to the nearest 0.1 kg, and height to the nearest 0.1 cm, using standard scales and stadiometer (Seca 217, Germany) with subjects wearing light clothing and no shoes. Body mass index (BMI) was calculated as the weight in kilograms divided by the height in meters squared.

Upper limbs muscle strength was assessed with the Handgrip Test (HG) on the right hand using a dynamometer (SH5001, SAEHAN Corporation, South Korea). For each measurement, patients were asked to perform their maximum voluntary contraction for 5 s. Each measurement was repeated three times with patients resting for 30 s between trials. The best performance was recorded for further analysis.

Lower limb muscle strength was assessed with the Isometric Knee Extension Test (KNEE), performed three times on the right leg with participants seated on a custom-built chair with a load cell (Vetek VZ101BS, Vaddo, Sweden). Each trial, participants were asked to perform their maximum voluntary contraction for 5 s. The test was repeated 3 times and participants rested for 2 min between trials. The best performance from the three trials was considered for further analysis.

Cardiorespiratory fitness was assessed with the Six Minutes Walking Test (6MW), performed according to the American Thoracic Society (American Thoracic Society, 2002) and the results expressed as the number of meters covered.

2.3. Statistical analysis

Descriptive statistical analysis, including mean and standard deviation, was calculated for both upper and lower limb muscle strength, and cardiorespiratory fitness, by group (EG, nEG, SG, and WG) and TIME (baseline, 6 months, 12 months).

A Repeated measures ANOVA with two between-subjects factors (PA and SEX) was run for each dependent variable (KNEE, HG, 6MIN), considering three TIME points (baseline, + 6 months, + 12 months). Mauchly's test was used to examine the assumption of sphericity for each analysis and whenever the estimates of sphericity ($\epsilon < .50$) were violated, degrees of freedom were corrected using the adequate method.

The α level was set at $p \leq 0.05$ for statistical significance. All statistical methods were performed using SPSS for Windows (ver. 22, SPSS Inc, Chicago, IL, 2013).

3. Results

The physical characteristics of the participants recruited in the present study by group, at baseline, are presented in Table 1.

No significant differences were found between groups in participants' physical characteristics.

The results of the within-subjects analysis (Table 2) showed in a main effect of TIME on Isometric Knee Extension, Handgrip, and 6 Min Walking (all $p < .004$); and no interaction between TIME x SEX (all $p > .05$), or TIME x PA (all $p > .05$), or between TIME x SEX x PA (all $p > .05$). A significant general effect for SEX and PA was also found on the between-subjects (groups) analysis (all p's < .001), and no

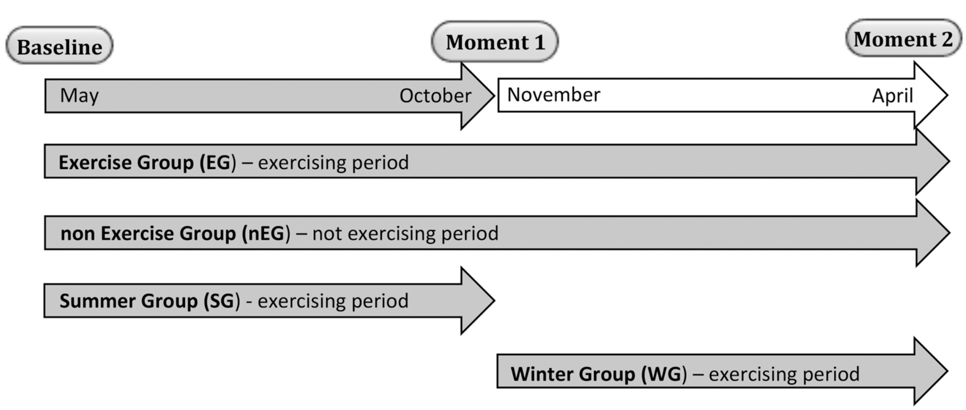

Fig. 1. Representation of assessment moments and groups' training period.

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