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# Differences Between Body Composition and Physiological Characteristics of Active/Inactive Elderly Women

## Diferencias Entre Composición Corporal y Características Fisiológicas de Mujeres Mayores Activas/Inactivas

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**SUMMARY:** Aging affects living organisms and produces a continuous degenerative change in most physiological functions, specifically in body composition. The aim of the present study is to compare the differences of body composition and physiologic characteristics according to physical activity levels and population of different geographical locations between active elderly participants (AP) of a Pilates-Aerobic interventional program and inactive elderly participants (IP). A total of 341 elderly women over 60 years (IP=69.92 ± 7.07; AP=68.85 ± 5.38) participated in this study, all of them from the Málaga province (Spain). The physical activity influenced to resting heart rate of participants (IP=78.2 bpm, AP=75.6; p<.05). Waist circumference and fat mass in IP that live in towns of <2.000 of population was the lowest (p<.05). In addition, in AP, weight, waist circumference and fat mass was the lowest too in towns of <2.000 of population (p<.05). The interaction of physical activity and population factors influenced resting HR, Diastolic Blood Pressure and fat mass (p<.01; p<0.5 and p<.05, respectively). In conclusion, elderly people have different physiological and body composition characteristics by a level of physical activity and the population in which they live. Active female participants who live in small areas and a number of inhabitants is limited, show the best physiological state to cope with aging.

**KEY WORDS: Body composition, ageing, physical activity, geographical location.**

## INTRODUCTION

Aging is a natural and inevitable process (Amarya *et al*., 2014), affecting living organisms and representing continuous degenerative changes in most physical and physiological functions (Trifunovic & Ventura, 2014). Moreover, it is common knowledge that aging causes drastic changes in body composition characteristics (Ruiz-Montero *et al*., 2013).

Fat mass (FM) increases and fat free mass (FFM) decreases during the period of 20-70 years of age (Colado *et al*., 2012). Maximum levels FM are found between 60-70 years of age (Gallagher *et al*., 1997). However, maximum levels of FFM is at 20 years of age and up to 40 % decrease until 70 years of age, primarily skeletal muscle (Baumgartner *et al*., 1995). Thus, FFM and FM are body composition states that change continuously and are more closely related to factors of aging process than others (Amarya *et al*.). However, another deterioration has been identified from approximately the age of 65 to 75-80 (Kyle *et al*., 2001), where the loss of skeletal muscle mass (SMM) becomes 25 % of the total (Short *et al*., 2004). The loss of SMM and strength during the aging process (sarcopenia) are the most important physiological changes related to loss of functional independence and mortality (Vogel *et al*., 2009).

According to Ruiz-Montero *et al*., there is an increase in FM with a reduction in SMM and physical capacity, along with a loss of FFM (Katula *et al*., 2006). An elderly, with more sedentary lifestyles, lose FFM faster than an elderly who is active. Consequently, there is prevention of weight loss and in maintaining functional capacity in physical activity practitioners over the age of 70 (Woo *et al*., 2013).

Other important body composition characteristic is the obesity. This is an excess of body fat that increases considerably the risk of mortal illness in general population, specifically in adult and elderly people (Kumanyika *et al*., 2007). Excess of FM and a body mass index (BMI) over 30-score is associated with a decrease of PA, possible futures disabilities (Davison *et al*., 2002) and excess body weight

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(Chen *et al*., 2004), while obesity is associated with the prevalence of diseases such as diabetes, hypertension, arthritis, cardiovascular risk, etc (Ruiz-Montero *et al*.)

The elderly population does not enjoy total well-being due to the physical limitations or chronic cardiovascular factors such as body composition changes, both being associated with limitations in functionality (Yoem *et al*., 2008). Physical inactivity and sedentary lifestyles are both causes of negative health consequences (Bergamin *et al*., 2012) Therefore, PA is considered as a forceful health indicator which produces benefits in the elderly, being used as an effective intervention to prevent functional loss related to age (Ikezoe *et al*., 2013). In addition, PA promotes an improves quality of life and, as a result, greater longevity (Ruiz-Montero *et al*.).

Industrialized societies are continuously worried about the increase of life expectancy and the promotion of healthier aging. Furthermore, the promotion of regular PA is considered one of the most important non-pharmaceutical measures in the prevention of aging effects (Vogel *et al*.). Therefore, the aim of the present study is to compare the differences of body composition and physiologic characteristics according to physical activity levels and population of different geographical locations between active participants (AP) of a Pilates-Aerobic interventional program and inactive participants (IP), all of them, elderly.

## MATERIAL AND METHOD

**Participants.** Participants of present study were recruited from a PA program of “Diputación de Málaga” (Spain) via telephone or direct contact. The total sample of examinees included in this research was composed of a population consisting of 341 elderly female participants attending a Pilates-Aerobic interventional program, over 60 years (IP=69.92 ± 7.07; AP=68.85 ± 5.38). The inclusion criteria were i) not to be diagnosed with an acute or terminal illness, ii) not have limited functional mobility . Male elderly participants were excluded because their number would not be representative of the total. Participants were informed of the purpose of the present study.

**Measurements.** A cross-sectional study was used to assess body composition characteristics of female elderly participants.

We measured weight (Kg), FM (Kg and %), SMM (Kg), FFM (Kg) and BMI categorized using international criteria as underweight (BMI < 18.5 kg/m2), normal weight (BMI 18.5–24.9 kg/m$^2$), overweight (BMI 25.0–29.9 kg/m$^2$), and obese (BMI >30.0 kg/m$^2$) by bioelectrical impedance analysis with a Tanita SC 330s. Waist circumference (cm) was measured with the participant standing at the middle point between the ribs and ileac crest (Harpenden anthropometric tape, Holtain Ltd., Crymych, UK). Height (cm) was measured using a stadiometer (Seca 22, Hamburg, Germany). The systolic blood pressure, diastolic blood pressure and heart rate were measured by tensiometer, model Omron M3 Intellisense.

According to population of geographical locations (village, town, cities) who participated in the PA program of “Málaga City Council” (Spain), the sample of participants was classified in groups according to National Institute of Statistic from Spanish Government (http://www.ine.es/): <2.000, 2.000-5.000, 5.000-10.000, 10.000-20.000, 20.000-50.000 and 50.000-100.000.

**Procedure.** Contents of the active female elderly participants were treated as upper and lower body strength exercises, agility and specially, aerobic capacity and Pilates method. The frequency of sessions was twice a week in the afternoon and lasting 45 minutes per session. Each exercise was by supervision of specialists.

When the participants agreed to collaborate, they were given socio-demographic and clinical questionnaires to verify if they were eligible under the criteria of inclusion and exclusion. This allowed ensuring that participants were not taking any medications and had no functional mobility problems.

**Statistical analyses.** The normal distribution of the data was studied using the Kolmogorov-Smirnov test. All the variables studied presented a normal distribution.

The collected data processing included the use of adequate statistical methods for calculating central and dispersion parameters: arithmetic mean and typical deviation. To determine the significance of differences of body composition characteristics, body composition characteristics were assessed by two-ways ANOVA (physical activity and population). Post hoc Bonferroni’s test for between-groups comparisons and t test for related samples were applied after significant ANOVA results. The magnitude of the differences in the pre-posttest of active and control groups were calculated using the effect size (h2p), according to Cohen (1992). The effect size can be interpreted as small (0.2<d<0.5), medium (0.5<d<0.8) or large (0.8<d). Data were analyzed using the SPSS statistical program (SPSS for Windows 21.0, Inc., Chicago, Illinois, USA). For all analyses, significance was accepted at p<.05.

## RESULTS

Body composition characteristics are shown in Table I. Participants with the same body composition, i.e. fat mass, skeletal muscle mass, body mass index, etc. However, results describe that physical activity influenced to resting heart rate whereas the IP has 78.2 bpm and AP has 75.6 ($p<.05$).

In Table II, resting HR, waist circumference and fat mass in IP that live in towns of <2.000 of population is the lowest ($p<.05$). In addition, in AP, weight, waist circumference and fat mass is the lowest too in towns of <2.000 of population ($p<.05$). Furthermore, skeletal muscle mass is highest in these towns, both AP and IP, although these differences are not significant ($p>.05$). Results showed through two-ways ANOVA that the interaction of physical activity and population factors influenced resting HR, Diastolic Blood Pressure and fat mass, $F(1,5)=2.86$, $p=.01$, $h2p=0.04$; $F(1,5)=2.60$, $p=.02$, $h2p=.04$; $F(1,5)=2.21$, $p=.05$, $h2p=.03$; respectively.

Table I. Body composition and physiologic characteristics according to physical activity.

| | IP (n= 157) | AP (n= 183) | p-value |
|---|---|---|---|
| Age (years) | 69.92 ±7.07 | 68.8 ±5.38 | .11 |
| SBP (mmHg) | 139.6 ±18.58 | 137. ±19.42 | .32 |
| DBP (mmHg) | 77.34 ±12.40 | 76.7 ±10.42 | .62 |
| Resting HR | 78.22 ±12.58 | 75.5 ±10.90 | .04 |
| Weight (Kg) | 71.16 ±12.63 | 71.7 ±12.78 | .66 |
| Height (cm) | 150.4 ±13.62 | 152. ±12.96 | .19 |
| WC (cm) | 100.3 ±12.16 | 100. ±12.92 | .93 |
| BMI ($kg/m^2$) | 31.05 ±5.07 | 30.4 ±5.17 | .31 |
| FM (%) | 44.78 ±5.84 | 43.7 ±10.14 | .26 |
| FM (kg) | 31.73 ±9.15 | 31.4 ±9.31 | .76 |
| SMM (kg) | 21.53 ±4.53 | 21.9 ±3.65 | .35 |
| FFM (kg) | 39.37 ±6.26 | 40.3 6 ±5.72 | .13 |

IP: Inactive Participants; AP: Active Participants; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate; WC: Waist Circumference; BMI: Body Mass Index; FM: Fat Mass; SMM: Skeletal Muscle Mass; FFM: Fat Free Mass.

Table II Body composition and physiologic characteristics according to the population.

| Population | | < 2.000 (n=44) | 2.000 - 5.000 (n=114) | 5.000 - 10.000 (n=50) | 10.000 - 20.000 (n=32) | 20.000 - 50.000 (n=45) | 50.000 - 100.000 (n=56) | p-value |
|---|---|---|---|---|---|---|---|---|
| Age (years) | IP | 69.1 ± 6.13 | 67.8 ± 5.52[6] | 70.2 ± 6.95 | 67.2 ± 5.01 | 72.0 ± 6.51 | 73.9 ± 9.56[2] | ‡ |
| | AP | 68.1 ± 4.67 | 68.7 ± 6.07 | 69.5 ± 4.91 | 67.9 ± 4.82 | 66.8 ± 4.67[6] | 71.6 ± 4.82[5] | † |
| SBP (mmHg) | IP | 142.5 ± 19.3 | 139.4 ± 21.2 | 141.7 ± 16.2 | 138.3 ± 20.1 | 139.3 ± 14.1 | 136.2 ± 18.8 | |
| | AP | 131.8 ± 19.5 | 135.1 ± 17.1 | 142.0 ± 21.7 | 141.1 ± 20.6 | 139.5 ± 20.3 | 138.5 ± 20.3 | |
| DBP (mmHg) | IP | 79.7 ± 12.9 | 81.3 ± 12.7[5] | 75.8 ± 9.43 | 77.0 ± 9.48 | 69.8 ± 9.09[2] | 76.2 ± 14.7 | ‡ * |
| | AP | 77.1 ± 10.2 | 76.3 ± 9.48 | 77.3 ± 8.81 | 77.8 ± 12.6 | 78.7 ± 13.4 | 74.4 ± 9.78 | |
| Resting HR (bpm) | IP | 69.7 ± 11.6[2, 6] | 84.1 ± 13.0[1, 3] | 73.5 ± 8.83[2] | 76.7 ± 12.9 | 75.4 ± 11.8 | 82.0 ± 10.2[1] | ‡ * |
| | AP | 77.0 ± 9.84 | 77.2 ± 10.5 | 71.3 ± 9.22 | 75.9 ± 10.9 | 74.0 ± 13.8 | 75.9 ± 11.0 | |
| Weight (Kg) | IP | 68.1 ± 8.06 | 72.6 ± 13.2 | 68.4 ± 11.2 | 76.5 ± 16.3 | 71.6 ± 10.1 | 71.2 ± 15.9 | |
| | AP | 66.9 ± 6.30[5] | 71.8 ± 12.6 | 71.6 ± 12.9 | 71.4 ± 14.0 | 78.9 ± 18.4[1] | 70.2 ± 7.85 | † |
| Height (cm) | IP | 149.0 ± 5.3 | 148.7 ± 22.7 | 153.1 ± 4.59 | 153.0 ± 7.42 | 150.6 ± 5.94 | 150.8 ± 7.95 | |
| | AP | 150.0 ± 6.37 | 148.8 ± 20.3[6] | 152.4 ± 6.84 | 157.3 ± 6.19 | 153.5 ± 3.57 | 156.8 ± 4.45[2] | † |
| WC (cm) | IP | 94.9 ± 10.8[2] | 102.9 ± 12.8[1] | 96.1 ± 9.61 | 102.3 ± 16.1 | 102.6 ± 8.68 | 101.0 ± 13.5 | ‡ |
| | AP | 91.8 ± 7.79[2, 5] | 102.7 ± 12.1[1] | 100.4 ± 13.3 | 100.0 ± 15.8 | 106.0 ± 13.9[1] | 96.2 ± 10.7 | † |
| BMI ($kg/m^2$) | IP | 30.7 ± 3.53 | 31.4 ± 5.09 | 29.4 ± 3.98 | 32.7 ± 7.32 | 31.5 ± 4.00 | 31.1 ± 6.65 | |
| | AP | 30.0 ± 3.20 | 31.3 ± 5.05 | 30.3 ± 5.42 | 28.4 ± 4.52[5] | 33.4 ± 7.15[4, 6] | 28.5 ± 3.61[5] | † |
| FM (%) | IP | 43.8 ± 6.29 | 44.3 ± 5.91 | 42.9 ± 5.72 | 46.7 ± 5.49 | 47.2 ± 4.75 | 45.3 ± 5.97 | * |
| | AP | 40.3 ± 7.63[2, 5] | 46.5 ± 14.4[1] | 44.3 ± 6.16 | 39.7 ± 7.09 | 45.6 ± 5.79[1] | 41.4 ± 5.66 | † |
| FM (kg) | IP | 27.7 ± 7.14[4] | 32.6 ± 9.46 | 28.3 ± 7.14 | 36.2 ± 10.8[1] | 34.1 ± 6.95 | 33.0 ± 11.1 | ‡ * |
| | AP | 26.0 ± 5.64[2, 5] | 32.9 ± 8.67[1] | 32.2 ± 9.21 | 28.9 ± 9.78[5] | 36.8 ± 12.7[1, 4, 6] | 29.4 ± 6.40[5] | † |
| SMM (kg) | IP | 23.0 ± 5.62 | 21.5 ± 3.12 | 22.7 ± 7.05 | 21.8 ± 4.10 | 20.0 ± 2.60 | 20.5 ± 3.83 | |
| | AP | 23.1 ± 5.00 | 21.1 ± 3.27 | 21.3 ± 3.28 | 23.1 ± 4.09 | 22.9 ± 4.00 | 22.0 ± 2.24 | |
| FFM (kg) | IP | 40.4 ± 6.23 | 39.9 ± 5.26 | 40.1 ± 8.86 | 40.3 ± 6.76 | 37.5 ± 4.36 | 38.2 ± 6.33 | |
| | AP | 41.0 ± 5.17 | 38.9 ± 5.73[4] | 39.4 ± 5.49 | 42.6 ± 6.76[2] | 42.1 ± 6.56 | 40.8 ± 3.69 | † |

* P < 0.05 (Two-ways ANOVA. Interaction Physical Activity and Population); † P < 0.05 (One way ANOVA: AP); ‡ P < 0.05 (One way ANOVA: IP); Bonferroni post hoc in superscript number; IP: Inactive Participants; AP: Active Participants; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate; WC: Waist Circumference; BMI: Body Mass Index; FM: Fat Mass; SMM: Skeletal Muscle Mass; FFM: Fat Free Mass.

## DISCUSSION

The main aim of this research article has been to compare the body composition and physiologic characteristics of AP and IP from different populations, according to physical activity levels. It is well known that the deterioration in the levels of functionality and physiological in the elderly´s organism, have consequences in basal metabolism, as well as body composition (Ruiz-Montero *et al*.). The elderly tend to move less and accumulate more fat mass. Thus, if the movement in elderly is reduced by reasons of social tendency, climatological or lack of resources, the might try to alleviate that fact.

In the present study, it has been verified that IP have a higher resting heart rate, which confirms the participants' natural physiological response, according to Ikezoe *et al*., and physical inactivity effects. In addition to the sedentary lifestyles, both of them are causes of negative health consequences during the aging process. Moreover, a high resting heart rate is a strong predictor of total and cardiovascular mortality in healthy patients, specially, in the elderly (Diaz *et al*., 2005). The reduction in $VO_2$ is not constant, although it is more apparent in men than it is in women. Furthermore, the decrease of $VO_2$ over the age of 60 is due to a reduction in maximum cardiac output and arterial-venous oxygen difference reduction. However, practice of physical activity produces improvement in the mean heart rate and $VO_2$ of female older participants (Bartolomeu *et al*., 2017).

On the other hand, the results show a wide difference between the populations of <2000 inhabitants compared to others groups of up to 100000 inhabitants. The population that lives in the places with the lowest number of in habitants, possess better physiological and body composition characteristics, that is, rest HR, weight, WC, FM, SMM and FFM. Adediran *et al*. (2013) confirm that anthropometric measures are better in rural populations than in urban ones, with a difference in the number of inhabitants between the two very remarkable and proving that the lifestyles are different. Furthermore, Higgs (1999) confirms that people living in rural populations (<5000 inhabitants) have better physical conditions and life-styles; therefore, a better quality of life.

According to Tyrovolas *et al*. (2016), body composition changes might be associated to lower quality of life in the aging process. The forms of displacement in the participants of rural areas could influence to participants' body composition also, because of the maintaining of a healthy locomotive system. There is an increase of disability-free life expectancy which includes body composition parameters such as SMM or FM (Nakamura *et al*., 2016). However, female participants from bigger populations were the oldest and they showed worse body composition and physiologic characteristics, even the AP. Aging process is associated to increase of BMI and FM of the elderly although, the elderly participant of physical activity usually present less increase of those body composition parameters (Muramoto *et al*., 2013). Thus, people living in urban populations with a greater number of inhabitants have higher risk factors for cardiovascular diseases, in which the RH is one of these factors.

An important limitation of this study is the interpretation of the situation in people under 60 years, to check if the physiological findings occur earlier and therefore, have data available when reaching old age. This fact can cause people in old age to have diseases that may limit their functional activity and, therefore, their daily lifestyle.

## CONCLUSION

As a conclusion, elderly people have different physiological and body composition characteristics according to the level of physical activity and the population in which they live. Active female participants who live in small areas and with smaller numbers of inhabitants, show the best physiological and physical state to cope with aging. It is difficult to distinguish the effect of aging on this physiological state from the effects of deconditioning or disease. Nevertheless, evidence exists that supports the benefits of physical activity in slowing physiologic changes of aging. A vigorous-intensive activity is recommended in order to improve their heart rate and systolic volume.

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**RUIZ-MONTERO, P. J. & CASTILLO-RODRÍGUEZ, A** Diferencias entre composición corporal y características fisiológicas de mujeres mayores activas/inactivas. *Int. J. Morphol., 36(1)* :262-266, 2018.

**RESUMEN:** Los efectos del envejecimiento afectan a los organismos vivos y producen continuos efectos degenerativos en la mayoría de las funciones fisiológicas, especialmente en la composición corporal. El principal objetivo del presente estudio es comparar las diferencias de la composición corporal y características fisiológicas, en función de los niveles de actividad física y la población de diferentes ubicaciones geográficas entre participantes mayoras activas de un programa de intervención Pilates-Aerobic y participantes mayores inactivas. Un total de 341 mujeres mayores de 60 años (inactivas=69.92±7.07; activas=68.85±5.38) participaron en este estudio, todas ellas de la provincia de Málaga (España). La actividad física influenció en la frecuencia cardiaca de las participantes (inactivas=78.2 pulsaciones por minuto, ppm, activas=75.6ppm; p<,05). El perímetro de cintura y masa grasa en participantes inactivas que vivían en ciudades <2.000 habitantes fue menor (p<,05). Además, en participantes activas, el peso, perímetro de cintura y masa grasa fue también la menor en ciudades <2.000 habitantes (p<,05). La interacción de actividad física y factores poblacionales influyeron en la frecuencia cardiaca, presión diastólica y masa grasa (p<,01; p<0,5 and p<,05, respectivamente). En conclusión, las personas mayores tienen diferencias fisiológicas y de composición corporal que vienen caracterizadas por el nivel de actividad física y la población en la que viven. Las participantes activas que viven en pequeñas áreas y en un número limitado de habitantes, muestran el mejor estado fisiológico para seguir adelante con el envejecimiento.

**PALABRAS CLAVE: Composición corporal; Envejecimiento; Actividad física; Ubicación geográfica.**

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