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# Effects of resistance exercise and dance in the functionality of lower limbs in the older adult of INAPAM's senior clubs

Efectos del ejercicio de resistencia y baile en la funcionalidad de miembros inferiores en el adulto mayor de clubes de ancianos INAPAM

Efeitos do exercício físico e da dança a funcionalidade dos membros inferiores em idosos dos clubes seniores do INAPAM

Effets de la résistance et exercice de danse dans la fonctionnalité des membres inférieurs chez les personnes âgées, des clubs seniors de l'INAPAM

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## Abstract

**Objective:** To determine the effect of resistance exercise routine and dancing in the lower limbs of no institutionalized elderly, cognitively intact, functional for basic activities of daily living without falling risks.

**Material and Methods:** A quasi-experimental study, the effect of an intervention on a single group, consisting of 26 persons aged 60 AM considering criteria of inclusion and non-inclusion was determined. The Short Portable Mental Status Questionnaire was used; Katz Scale and the Scale of Tinetti. The information obtained was analyzed in two stages, descriptive and inferential. In the first phase, frequency distribution tables and measures of central tendency and dispersion for all variables were obtained, as discussed in qualitative or quantitative variables, respectively. In the second phase, the effect of the intervention trophism comparing averages, muscle strength and arcs of movement group and individual pre- and post-intervention was evaluated.

**Results:** There was a trend for improvement in the flexibility of the hip, knee and ankle mostly knee extension remained the same, 84.61% and 80.76% right left. Left hip extension remains the same at 50% and 53.84%, the right side. Muscle strength increased overall in all muscle groups of both lower extremities. Trophism increased in diameter thighs, calves by 46% and over 50% were similar diameters, some of the older adults lost weight so their diameter decreased.

**Conclusions:** This program showed significant changes in muscle strength and range of motion in the study participants could see the significant association between dancing Zumba Gold and resistance exercises to increase muscle strength, flexibility lower extremities and increased level of activity in older adults. Exercise and physical activity are important for the positive effects that cause health and improvements in the diameter of the thighs and increased functionality of the elderly.

**Key words:** Elderly, resistance exercise, Zumba Gold, sedentary lifestyle, muscle trophism, muscular strength

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## Resumen

**Objetivo:** Determinar el efecto de una rutina de ejercicios de resistencia y baile en miembros inferiores de adultos mayores no institucionalizados, cognitivamente íntegros, funcionales para actividades básicas de la vida diaria, sin riesgo de caídas.

**Material y métodos:** Estudio cuasi-experimental, se determinó el efecto de una intervención sobre un grupo único, constituido por 26 personas AM de 60 años considerando criterios de inclusión y de no inclusión. Se utilizó el Short Portable Mental Status Questionnaire; la Escala de Katz y la Escala de Tinetti. La información obtenida fue analizada en dos fases, descriptiva e inferencial. En la primera fase, se obtuvieron tablas de distribución de frecuencias así como medidas de tendencia central y de dispersión para todas las variables, según se trató de variables cualitativas o cuantitativas, respectivamente. En la segunda fase, se evaluó el efecto de la intervención comparando los promedios de trofismo, fuerza muscular y de arcos de movimientos, individuales y grupales pre- y post intervención.

**Resultados:** Hubo tendencia a la mejoría en la flexibilidad en cadera, rodilla y tobillo en su mayoría, la extensión de rodilla se mantuvo igual, 84.61% derecha y 80.76% izquierda. La extensión de cadera izquierda permanece igual en un 50% y 53.84%, del lado derecho. La fuerza muscular incrementó en general en todos los grupos musculares de ambas extremidades inferiores. El trofismo de muslos aumentó en su diámetro, las pantorrillas en un 46% y más del 50% mantuvieron diámetros similares. Algunos de los AM bajaron de peso, por lo tanto sus diámetros disminuyeron.

**Conclusiones:** Este programa mostró modificaciones significativas en la fuerza muscular y rangos de movimientos en los participantes del estudio, se pudo ver la asociación importante que existe entre el baile de Zumba Gold y Ejercicios de Resistencia con el incremento de la fuerza muscular, flexibilidad de las extremidades inferiores y el incremento en el nivel de la actividad en los adultos mayores. El ejercicio y la actividad física son importantes, por los efectos positivos que causan sobre la salud y la mejoría en el diámetro de los muslos y el aumento en la funcionalidad del adulto mayor.

**Palabras clave:** Adulto mayor, Ejercicio de resistencia, Zumba Gold, Sedentarismo, Trofismo muscular, Fuerza muscular

## Resumo

**Objetivo:** Para determinar o efeito de uma rotina de exercícios de resistência e dança nos membros inferiores de idosos não institucionalizados, cognitivamente íntegros e funcionais para atividades básicas da vida diária, sem risco de queda.

**Material e métodos:** Estudo quase experimental, determinou-se o efeito de uma intervenção sobre um único grupo, constituído por 26 pessoas AM de 60 anos considerando critérios de inclusão e não-inclusão. Utilizou-se o Short Portable Mental Status Questionnaire; a escala Katz e a escala de Tinetti. A informação obtida foi analisada em duas fases, descritiva e inferencial. Na primeira fase, foram obtidos tabelas de distribuição de frequência assim como medidas de tendência central e de dispersão para todas as variáveis, segundo se tratou de variáveis qualitativas ou quantitativas, respectivamente. Na segunda fase, avaliou-se o efeito da intervenção através da comparação da média de trofismo, força muscular e arcos de movimentos, individual, em grupo pré- e pós-intervenção.

**Resultados:** Houve uma tendência de melhora na flexibilidade do quadril, joelho e tornozelo principalmente, a extensão do joelho permaneceu a mesma, 84,61% direita e 80,76% para a esquerda. A extensão do quadril esquerdo permanece igual em um 50% e 53,84%, no lado direito. A força muscular aumentou geralmente em todos os grupos musculares de ambas as extremidades inferiores. O trofismo de coxas aumentou em diâmetro, pantorrilha em um 46% e mais do 50% mantiveram diâmetros semelhantes. Alguns dos AM perderam peso, pelo que os seus diâmetros diminuíram.

**Conclusões:** Este programa mostrou mudanças significativas na força muscular e amplitude de movimento nas participantes do estudo, pôde-se ver a associação significativa que existe entre a dança Zumba Ouro e Exercícios de Resistência com o aumento da força muscular, flexibilidade das extremidades inferiores e o aumento no nível da atividade em adultos mais velhos. O exercício e a atividade física são importantes, pelos efeitos positivos que causam sobre a saúde e a melhoria do diâmetro das coxas e do aumento da funcionalidade do idoso.

**Palavras-chave:** Idoso, Exercício de resistência, Zumba ouro, Sedentarismo, Trofismo muscular, Força muscular.

## Résumé

**Cible:** Déterminer l'effet d'une routine d'exercices de résistance et de danse sur les membres inférieurs de personnes âgées qui ne sont pas internées, cognitivement intacts et qui sont fonctionnels pour réaliser des activités de base de la vie quotidienne, sans risque de chute.

**Matériel et méthodes:** Une étude quasi-expérimentale a été réalisée pour déterminer l'effet d'une intervention sur un seul groupe, composé de 26 personnes âgées de 60 ans, compte tenu des critères d'inclusion et de non-inclusion. Le questionnaire « Short Portable Mental Status », l'échelle Katz et l'échelle Tinetti ont été utilisés. L'information obtenue a été analysée en deux phases, une descriptive et l'autre de déduction. Dans la première phase, des tableaux de distribution de fréquence ont été obtenus ainsi que des mesures de tendance et de dispersion centrales pour toutes les variables, selon qu'elles soient des variables qualitatives ou quantitatives, respectivement. Dans la deuxième phase, l'effet de l'intervention a été évalué en comparant les moyennes de trophisme, de la force musculaire et des arches de mouvement, individuels et collectifs avant et après l'intervention.

**Résultats:** Il y a eu une tendance à l'amélioration de la flexibilité dans la hanche, le genou et la cheville dans la majorité, l'extension du genou est restée la même, 84,61% à droite et 80,76% à gauche. L'extension de la hanche gauche reste la même à 50% et 53,84% sur le côté droit. La force musculaire a augmenté globalement dans tous les groupes musculaires des deux extrémités inférieures. Le trophisme des cuisses a augmenté dans son diamètre, les mollets ont augmenté de 46% et plus de 50% ont conservé des diamètres similaires. Certaines personnes âgées ont perdu du poids, donc leur diamètre a diminué.

**Conclusions:** Ce programme a montré des changements significatifs dans la force musculaire et dans les variations de mouvement chez les participants de l'étude, nous pouvons voir l'association importante qui existe entre la danse Zumba Gold et les exercices de résistance avec l'augmentation de la force musculaire, de la flexibilité des membres inférieurs et de l'augmentation du niveau d'activité chez les personnes âgées. L'exercice et l'activité physique sont importants en raison des effets positifs qu'ils provoquent sur la santé, l'amélioration du diamètre des cuisses et l'augmentation de la fonctionnalité des personnes âgées.

**Mots-clés:** Personnes âgées, exercices de résistance, Zumba Gold, mode de vie sédentaire, trophisme musculaire, force musculaire, arches de mouvement.

## Introduction

In the latest years in Mexico, there has been a gradual change in the demographic transition, because the number of people aged 60 or over has increased due to an increase of life expectancy. This phenomenon is occurring worldwide and that is also very evident in our country. "Between 2015 and 2050, the world's population over 60 years old will triple and go from 900 million to 2,000 million. Most of this increase 80% will occur in less developed countries<sup>1</sup>.

On the other hand, in our country there has been an increasing interest in the growth of this population group. Population and Housing Census, CONAPO, 2011 indicates that in Mexico there are more than 7 million people aged 65 and over, representing 6.3% of the total population, 3.8 million are women and 3.2 are men. This growth of older adults has been considerable in the last thirty years, by 1970 people aged 65 and over totaled 1.8 million and the aging rate was 8 older adults for every one hundred under 15 years old; it increased to 13.7 per hundred and in 2010 it doubled compared to the information obtained 10 years earlier (21.4 per hundred)<sup>2</sup>.

This growth of older adults will require more attention and timely services for both the health system and their families to prevent diseases and thus allow them to reach an aging with a good quality of life. This population demographic change will bring great political, social, economic and health sector consequences. Aging is a very complex process in which it had not been given the necessary attention and in which currently in Mexico both society and health services, are not prepared to face it.

In Mexico, a person older than or equal to 60 years of age is defined as "older adult"<sup>3</sup>. According to the National Population Council (CONAPO), the number of people over 65 increased between 1970 and 2010, from 1.8 to 7.0 million. After 2010 these amounts increased considerably, expecting them to be 28.7 million by 2050.<sup>(2)</sup> Currently there are almost 13 million people over 60 in Mexico, equivalent to 10 percent of the population. But correlating to projections of CONAPO, in 2030 that population will reach 20 million 365 thousand 839 people<sup>4</sup>.

In 2013, Tabasco had 181 942 older adults, it is expected that by 2025 it will have 330 884 and by 2030 the number will increase to 408 859. That is, 8.09%, 13.38% and 16.11% respectively. Tabasco also has low rates of aging, whose magnitudes represent less than half of what the Federal District reports. It is in a moderate phase or in full demographic transition, with high or intermediate levels of fertility, which is reflected in rates below 31 older people per one hundred under 15 years<sup>5</sup>. Tabasco has a pattern of about 142 thousand adults over 60 years<sup>6</sup>.

In the municipality of Centro where Villahermosa is located, the proportion of adults over 65 went from 23,418 in 2006 to 31,364 in 2013, and it is expected that by 2025 it will reach approximately the number of 56,277<sup>7</sup>.

Normally the older adult presents great psychological, biological and social changes and few are those who enjoy a full life in this last stage of life. The normal process of individual aging produces a reduction of up to 25 to 30% of the cells that make up the different organs and systems of the human being, which translates into a decrease in the function fulfilled by that organ and system<sup>8</sup>.

In a national sample of the 2010 Census, among the most frequent difficulties reported for older adults, limitation in mobility stands out, 71.4% have this disability. Women outperform the male population in difficulty walking or moving (74.5% versus 67.5%, respectively). In Tabasco, the mobility limitation stands out, 68.6% of older adults have this disability. Women outperform the male population in difficulty walking or moving (73.5% vs. 62.5%, respectively). Therefore, one of the great challenges in public health will be to promote the maintenance of the functionality of the elderly, especially the musculoskeletal system. Soberanes and Cols.<sup>9</sup>, define that "The functional state is the result of the interaction of psychological and social biological elements and constitutes the most faithful reflection of the integrity of the individual during aging".

This is why the importance of developing exercise programs that help a culture in this last stage of life, promoting active aging as a way of life where the older adult is more independent in their activities of daily life, looking for their capabilities are maintained at a good level to avoid risks of injuries, falls and disabilities ranging from a minor deterioration to a major one caused by the progressive loss of their physical capacities especially the musculoskeletal system and that way we can have a larger adult population with a good quality of life.

## Materials and Methods

A quasi-experimental study of a single branch was performed with a before and after study where a previous evaluation was carried out, an intervention was carried out and it was re-evaluated to identify the changes that occurred after the intervention. By intervention refers to the program designed especially with the intention of improving the universe of study that was constituted by 26 older adults members of clubs of elders of the National Institute for Older Persons (INAPAM), Tabasco's Delegation. The study was carried out in the period from January 1 to November 30, 2014 and was evaluated by the bioethics committee of the INAPAM Delegación Tabasco and the Academic Committee of the

Master's Degree in Social Gerontology, of the Universidad Juárez Autónoma de Tabasco.

A non-probabilistic sample was studied for convenience, in which all older adults who fulfilled the selection criteria defined for the research were included. The older adult of any gender were included, active users of INAPAM Delegation Tabasco's elderly clubs, with normal cognitive function according to the Short Portable Mental Status Questionnaire, independent for all the basic activities of daily life indicated in the Katz Scale, without risk of falls according to the Tinetti Scale, who agreed to participate in the study. Older adults of any sex were excluded, who fulfilled one or more of the following conditions: 1) Absence to the program; 2) Cognitive impairment in any degree according to the Short Portable Mental Status Questionnaire; 3) Dependence for at least one of the basic activities of daily life indicated in the Katz Scale; 4) High risk of falls according to the Tinetti Scale; 5) Do not accept to participate.

The following variables were included: only to identify the study subjects age, sex, sedentary lifestyle, diseases of previous diagnosis. Muscle trophism, muscle strength and arcs of movements were evaluated in two moments of the study at the beginning and at the end of the intervention. The variables age, sex, sedentary lifestyle and diseases of previous diagnosis were considered descriptors of the population, while the variables trophism and muscular strength, as well as arcs of movement, were considered variables dependent on the intervention.

**Instruments.** - Different instruments were used to obtain the results:

**Short Portal Mental Status Questionnaire.** - It is a questionnaire hetero-applied with 10 items, on very general and personal questions. Explore short-term memory, Guidance, Information about everyday events and the ability to calculate. Its interpretation detects both the presence of cognitive impairment and the degree of it. Despite being designed for screening, it does not detect minor impairments or small changes in the evolution of cognitive impairment. It is a very quick test to administer that does not require special training.

**Katz Scale.** - Although it was designed as an index of rehabilitation, it has been used in the assessment of many chronic diseases such as cerebral infarction or rheumatoid arthritis, both in institutionalized and ambulatory patients. Nowadays it is the most used scale at the geriatric and palliative level. It assesses six basic functions (bathing, dressing, use of W.C, mobility, continence of sphincters and feeding) in terms of dependence or independence, grouping them later into a single summary index. The main limitations

of the Katz scale are those tasks that are highly dependent on the upper extremities and their poor sensitivity to change<sup>10</sup>.

**Tinetti Scale.** - Scale that is very common to evaluate the risk of falls in elderly people in the field of geriatrics. This scale evaluates several parameters related to balance by attending different body positions: seated, trying to get up, and standing, with closed eyes and with a 360 ° turn. This evaluation has a score of 0 to 2 depending on the difficulty that the participant presents, being 0 = difficulty, 1 = able with help and 2 = independent. The maximum total score is 16 points, so the higher the score, the lower the risk of falling<sup>11</sup>.

**Measurement of Mobility Arcs (goniometry).** - Applied to the medical sciences, the technique of measuring the angles created by the intersection of the longitudinal axes of the bones at the level of the joints is considered.

In medicine it has two main objectives: To evaluate the position of a joint in space. In this case, it is a static procedure that is used to measure and quantify the absence of mobility of a joint and evaluate the arc of movement of a joint in each of the three planes of space. In this case, it is a dynamic procedure that is used to objectify and quantify the mobility of a joint<sup>12</sup>.

**Scale of Daniels of Muscle Strength Assessment.** - Qualifies the muscular function according to six levels, numbered from "0" to "5", giving each of them a specific quality of the movement, which tried to improve the assessor reproducibility of measure. Its objective is to assess the amount of muscular strength on a scale of 0 to 5. The strength of a single muscle is not specifically measured because there are no isolated contractions, but strength is measured through joint movement<sup>13</sup>.

**Perimeter Measurement Techniques (Cross-Handed Technique).** - The most common technique is called cross-handed technique, where with the left hand you take the end of the tape and pass it around the segment to be measured.

In general, the indexes and thumbs of both hands control the tension and the alignment of the tape; On the other hand, the middle fingers guarantee, on the sides, the correct level of measurement, observing their perpendicularity of the segment to be measured. Special care should be taken to avoid compression of the skin and subcutaneous cellular tissue by the measuring tape<sup>14</sup>.

Apparatus used for the evaluation of trophism, muscle strength and movement arcs: Tape measure: Graduated in centimeters, plastic goniometer: Graduated in degrees to measure angles of movement, both hands of the evaluator. A



half pound gaiter was used to perform a series of exercises for lower limbs, indicated on a sheet given to them during the first evaluation with images included in the way they should have done them twice a day as a home program. The Zumba Gold dance, aimed at developing activities of locomotion and strengthening of the lower limbs, was performed three times a week for half an hour each time after heating for 10 minutes and then stretching. Depending on the physical condition of the group, it was increased to one hour, which happened in the middle of the period (one month and a half), with the direction of three female trainers specialized in this rhythm from the Gym Ateneo, during a period of three months (47 sessions). All sessions were held at the Gym Ateneo facilities.

### Evaluation of the prospects.

It was carried out in the offices of the Guerrero Medical Unit where the elderly were explained in a very detailed manner in what the program consisted of. Once it was understood, an informed consent form was provided, specifying their participation, the duration, the objective, its possible risks and benefits to carry it out, and once accepted they signed it, noting their name, INAPAM credential number, full name and signature, date and place. One of the clauses of the consent explained that this could be revoked at any time, either voluntarily or in the event that any physical condition against it occurred during the period of the investigation. The anonymity and privacy of all participants was protected at all times. Subsequently, the different evaluation techniques were applied. The information collected was analyzed in two phases, descriptive and inferential. In the first phase, frequency distribution tables were obtained, as well as measures of central tendency and dispersion for all the variables, depending on whether they were qualitative or quantitative variables, respectively. While, in the second phase, the effect of the intervention was evaluated by comparing the averages of trophism and muscular strength, as well as arcs of movements, individual and group pre- and post-intervention.

Due to the participants performed moderate intensity exercises, it is considered a low risk study. Resistance exercises for lower limbs were applied using leg gaiters for the lower limbs in order to increase strength, trophism and muscle tone and also the Zumba Gold dance. Becoming less active during aging is the cause of the loss of strength and endurance. Zumba Gold can improve muscle strength, posture, mobility and coordination. Another benefit is that it helps to counteract a sedentary lifestyle. Refers Alonso, I<sup>15</sup> "as an aerobic exercise the Zumba Gold dance allows weight loss through the burning of calories, improves physical condition and muscle tone". The areas of the body where most changes occur with their practice are on the legs and

buttocks, followed by the abdomen and arms, also increases the tolerance to the accumulation of lactic acid. The resistance exercises and the zumba Gold dance were applied for 3 months. During the study, although being of low risk, the principal investigator and collaborators remained attentive in each session before any eventuality to suspend these or if it was necessary to withdraw the participant. The research team remained alert for any signs of over exertion such as nausea, dizziness, fatigue, chest pain or any other discomfort such as the arms or lower limbs.

### Results

The study was conducted in a total of 26 older adults, which were those who fulfill the inclusion criteria for the study, initially there was a population of 46 older adults who were invited to participate in the study. A simple statistic was performed where percentages were obtained, which are described in tables below for better understanding.

The results of the measurement in the plantiflexion show that there really were no changes. In almost all cases the percentage was maintained, however, we see that in the left lower extremity there was an increase in this. Regarding dorsiflexion, there is an increase in the right lower extremity, but it is striking that the left side remains largely unchanged in half of the participants. Inversion and eversion undergo a major change towards improvement. Few were the participants who had worsening in these arcs of movements. In flexion of the knee improvement in knee flexion of both lower limbs was observed. Although the extension remains the same in a good percentage. As for the hip flexion of the right pelvic member is the same as in the left. In the extension this arc of movement of the left hip remains the same in 50% of the participants and in 53.84% remains on the right side. In the abduction and internal and external rotations there is an increase towards the improvement of these arcs and in the adduction remains unchanged in almost 50% in both lower extremities table 1.

As for the results of muscular strength, it exhibits an increase in muscle strength in the whole group of muscles that make up the hip. If observed, in both extremities the increase was important. Few participants were those whose muscle strength worsened.

The muscular strength increased in the two pelvic limbs, especially with a left predominance. As for the muscle strength in the gastrocnemius muscles, those in charge of standing on ends and in the case of the peroneus muscles the increase was important table 2.

When analyzing the diameter of the thighs that there was an improvement of the thighs in their diameter, the calves

**Table 1:** Results of the Ankle, Knee and Hip Joint Movement Arcs

ANKLE	BETTER		EQUAL/SAME		WORSE	
	RIGHT %	LEFT %	RIGHT %	LEFT %	RIGHT %	LEFT %
PLANTIFLEXION	46.15	46.15	46.15	38.46	0	7.6
DORSIFLEXION	42.3	30.76	38.46	50	7.6	7.6
INVERSION	57.69	61.53	26.92	19.23	0	7.6
EVERSION	46.15	53.84	26.92	23.07	11.38	3.84
KNEE						
FLEXION	69.23	57.69	19.23	30.76	0	0
EXTENSION	0	0	84.61	80.76	0	3.84
HIP						
FLEXION	69.23	50	19.23	38.46	7.69	3.84
EXTENSION	34.61	38.46	53.84	50	3.84	0
ABD	50	42.3	38.46	38.46	7.69	11.53
ADD	30.76	34.61	46.15	50	19.23	11.53
INTERNAL ROTATION	53.84	50	42.3	42.3	3.84	7.69
EXTERNAL ROTATION	69.23	50	23.07	42.3	3.84	3.84

Source: Data collection card.

a percentage between 46% and more than 50% maintained their same diameters and in some of the participants decreased caused by the weight loss that some had table 3.

## Discussion

The results of this study are consistent with those of other studies reported by different authors on the subject, which in descriptive studies, like this study, have found that the increase in muscle strength and lower limb mobility predominates. Muscle strength in healthy men and women, previously untrained, may increase assuming that the training load sufficiently exceeds the normal daily activities of a particular muscle<sup>16</sup>.

From the point of view of public health, endurance exercise increases the muscular strength of the lower limbs, particularly in older adults where this may allow better performance in carrying out their basic activities of daily life, as well as instrumental.

Exercise and physical activity are important, due to the positive effects they cause on the improvement of health, increasing functional capacity, increasing years of independent active life and improving the quality of life of people<sup>17</sup>.

Some authors such as Vidarte, J.A. and Cols.<sup>18</sup> related to flexibility, report that in their study based on a physical exercise program in the elderly, they do not find changes in the flexibility of the lower limbs, although in most research studies such as this, they report changes by exercise in the lower extremities.

Other authors such as Peterson and Cols.<sup>19</sup>, mention that there is a relationship between resistance exercise and improvement of upper and lower body strength among elderly. From a public health perspective, these results confirm the value of the Resistance Exercises for the prevention or treatment of muscle-related age-related decline, which can in turn serve as a safeguard against disability. In particular, in his study, the main effects were observed for the lower part of the body, (ie leg weight = (29%), knee extension = (33%).) These findings are of great clinical value, taking into consideration the decrease in the exaggerated force that occurs in sedentary individuals after 50 years.

Dancing is a form of physical activity that could allow older adults to improve their physical functioning, well-being and health. Keogh, J.W.L. and Cols.<sup>20</sup>, report that there are no reviews on the physical benefits of dancing for healthy older adults that have been published in the scientific literature.



**Table 2:** Results of the Hips, Gluteus Minimus, Schutters, Knees Muscle strength

HIP MUSCLES	BETTER		SAME		WORSE	
	RIGHT%	LEFT%	RIGHT%	LEFT%	RIGHT%	LEFT%
PSOAS MAJOR	65.38	73.07	34.61	19.23	3.84	3.84
GLUTEUS MAXIMUS	80.76	69.23	26.92	23.07	0	3.84
GLUTEUS MEDIUS	80.76	69.23	26.92	23.07	0	3.84
GLUTEUS MINIMUS	80.76	69.23	26.92	23.07	0	3.84
	80.76	80.76	15.38	11.53	3.84	0
KNEE MUSCLES						
QUADRICEPS	80.76	96.15	11.53	3.84	3.84	0
HAMSTRINGS	61.53	84.61	30.76	15.38	0	0
ANKLE MUSCLES						
PREVIOUS TIBIAL	65.38	80.76	38.46	19.23	3.84	0
TIBIAL POSTERIOR	80.76	88.46	11.53	11.53	7.69	0
FOOT MUSCLE						
GASTROCNEMIUS	42.3	42.3	53.84	57.69	0	0
LONG SIDE FIBULA	92.3	92.3	3.84	3.84	3.84	0
LONG SHORT FIBULA	96.15	92.3	3.84	3.84	3.84	0

Source: Data collectioncard.

**Table 3:** Results in percentages of the muscle and calf diameters

DIAMETERS	INCREASE		SAME		DICTREASE	
	RIGHT %	LEFT %	RIGHT %	LEFT %	RIGHT %	LEFT %
THIGH	42.3	46.15	26.92	23.07	30.76	30.76
CALF	34.61	30.76	46.15	53.84	19.23	19.23

Source: Data collectioncard.

It is not until 2012 that a study emerged in the scientific literature that was designed to compare the perceived benefits of dancing with that of physical exercise. Using the Zumba Gold as an instrument, by comparing the frequencies and examining the data through a series of T tests (independent). It was found that both dancers and athletes perceived a wide range of benefits of participating in their respective activities<sup>21</sup>.

In relation to the time of the program there is similarity with the program (EXDASE) "Effect of Dance Exercise for the Elderly", where it was found that with a 3-month program once a week, the exercise had a positive effect on the results related to mobility among previously sedentary residents. However, this program of Zumba Gold dance and resistance exercise gives us an improvement in mobility and muscular strength since this, like the article mentioned above, was carried out for three months, with the difference that the Zumba Gold dance was performed for three months, three

hours per week. This confirms what was mentioned at the beginning of the discussion, where muscle strength can increase according to the daily training loads of a muscle.

The results obtained in the research work of Soto, JR, and Cols.<sup>22</sup> used Tai-Chi as a physical activity in older adults, these showed improvements in the static and dynamic balance, in the flexibility and strength of the lower and upper limbs as well as improvements in cardiovascular endurance. This program based on dance was found to improve the strength of the lower extremities of the body measured by the test of getting up from a chair, in previously sedentary volunteers and in independent older adults with previous physical activity.

Their results suggest that the findings with older adults with normal functioning can be transferred successfully to the most affected populations<sup>23</sup>.

This study showed changes in flexibility and muscle strength of the lower limbs in older adults who performed this double Zumba Gold dance program and resistance exercises for three months. No research work was found in the scientific literature where both instruments have been used to analyze the increase in muscle strength and range of movements of the lower limbs.

## Conclusions

This program showed modifications similar to those found by other authors in the muscular strength and range of movements. In the study participants it was possible to see the improvement that exists between the Zumba Gold dance and Resistance Exercises with the increase of muscular strength, flexibility of the lower extremities and the increase in the level of activity in older adults. Exercise and physical activity are important, because of the positive effects they cause on health and the improvement in the diameter of the thighs and the increased functionality of the elderly. This study was oriented to the process, but it would be interesting in a future study to establish statistical models to measure each one of the results and make them generalizable to the population.

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