Intervention between Resistance& Aerobic training (IRAT) program on immune level and muscle strength for elderly women

Hala Eid Mohamed Ibrahim
Department of Biological Science & Sports Health, Faculty of physical education- for Girls, Helwan university.
hala.eid@pef.helwan.edu.eg

Doi: 10.21608/isjpes.2023.224193.1087

Abstract

Introduction: *The age- related to immune level decline affects many organs and organ systems which in turn has an effect on in components of blood cell {Hemoglobin, Wight Blood Cells, Red Blood Cells, Platelets, Lymphocyte, Monocytes & Neutrophil, as well as on cardio respiratory and musculoskeletal fitness. Evidence from longitudinal studies demonstrates that physical activity may attenuate this observed decline in fitness.*

The aim: *of the current study was to study the effect of intervention resistance - Aerobic training* ***(IRAT)*** *12 weeks, 3 times per week) on Changing immune-level and decreased risk of infection in elderly women.*

Methods: *ten female subjects from police club aged 60-70 years were recruited through advertisements. They underwent an assessment of health state before testing and starting the exercise program controlled in the same training session for trained 3-month, three times a week, 60 min per session, on non-consecutive days and exercised under the supervision of a personal trainer, to determine changes in components of blood cell {Hemoglobin, Wight Blood Cells, Red Blood Cells, Platelets, Lymphocyte, Monocytes & Neutrophil}*

Result: *Blood samples were obtained from all subjects {IRAT} pre at rest, post immediately after resistance exercise training, before start program and after week 12 after training. T-test for paired samples was performed to compare both time points (level of significance $p<0.05$).*

Conclusion: *Increased components of blood cell and musculoskeletal after intervention between Resistance & Aerobic Training (IRAT) suggests that immunity has been improved*

Key words: intervention resistance & aerobic training, component of blood cell & muscle strength

Introduction:

Ageing is an integral and natural part of life. Growing old however not only is influenced by our genes, immune but also on what has been done during whole the life - on how and where we lived (Loue and Sajatovic, 2008). Lifestyle for aging are strongly related to immune function. Older adult related to lack of physical activity, poor nutrient, lack of sleep and depression,, all of that related to impaired immune-function and elevated risk of infection.

In recent decades life expectancy in the USA and Europe has been prolonged in men and women to approximately 74 years and 80 years, respectively (Rooke et al., 2020). Many factors contribute to this development, but medical progress seems to be the most effective one (Schneider et al., 1999) Demographical data indicate that the elderly are the most rapidly growing segment of the population in industrialized countries (Rooke et al., 2020). Currently, in the eastern Mediterranean region, with enhanced interest in senior health care and longevity as it also results in an increased productivity and in longer independence. However, optimal health care service needs access to quality medical and Immunological assessment, effective treatment plans, culturally sensitive medical care and specific social programs (Maria Teresa Tomás et all 2018)

A recent study of the WHO shows that in the Eastern Mediterranean Region, there is an increase in the number and in percentage of the population aged 60 and older (World Health Organization, 2020). The number of persons aged 60 and older in the region was around 26.8 million (5.8% of the total population) in 2020. It is projected that in 2025, older persons will

make up nearly 8.7%, and by 2050 nearly 15% of the population (World Health Organization, 2010). In Egypt, the country were this study took place, there has been a significant increase in people older than 60 years in recent years.

Aging is a complex process that ultimately leads to irreversible biological changes. However, health habits can have a sizable influence on life expectancy and quality of life, even in old age. A new and growing area of research is the relationship between certain lifestyle factors (in particular, physical activity, diet and immune senescence (Maha Sellami, Nicola Luigi Bragazzi et al 2021).

Aging associated loss of muscle quantity and quality is associated with biological changes that may affect an elder`s ability to move or exercise comfortably and effectively and has a negative influence on quality of life (Evans et al., 1997; Ettinger, 2016). As mentioned above, lean body mass diminishes with the loss of skeletal muscle mass, and this change also plays a role in the decrease of the basal metabolic rate (Campion, 1998) resulting in further changes of body composition. Many elderly persons however do not react with a corresponding decrease of their calorie intake to match this decrease in metabolism which in turn leads to a disproportionate enhancement in body fat (Cullinen, K., Caldwell, M., 2018) Generally spoken, aging reflects a progressively decreased anabolism and an increased catabolism at the same time (Lene Salimans, Keliane Liberman et al,2022).

Loss of independence may occur due to the role that strength plays in the performance of functional activities of daily living and in the prevention of falls (American College of Sports Medicine. 2019). It has been demonstrated that increased strength may improve w immunity and body composition in the elderly. It follows that such changes may prolong independent functioning, decrease the occurrence of falls, and result in an enhanced quality of life. The positive effects of resistance training on musculoskeletal function in young adults are well known, and recent reports have documented similar positive adaptations in the elderly. Resistance training has been reported to increase strength , muscle size (and resting metabolic rate and functional capacity in older individuals. reported a 17% increase in strength, concomitant with a 9% increase in muscle size, in female nonagenarians after only 12 week of resistance aerobic training, This means that muscle strength, power and endurance contribute to independence and reduces disability of seniors and enhances their quality of life **(Garcia**-Rubi, E., Starling, R.D 2018)

Although research on the role of resistance aerobic training on the immune systems of elderly human subjects is just beginning, data from the few available studies are intriguing and have potential for widespread public health influence. (Dvorak, R.V., DeNino, W.F.,2000) Many studies have compared immune function in highly conditioned and sedentary elderly (ie, ≥ 65 years) men and women. The highly conditioned participants exhibited superior function of natural killer and T-lymphocytes compared with the 30 sedentary elderly women. Another study compared immune function in 17 elderly runners, who had trained for about 17 years, and 19 elderly controls, and reported significantly higher T-lymphocyte function in the elderly runners (Fry, R. W., A. R. Morton, G. P. M 1992)

Although the initiation of moderate exercise by the elderly did not alter chronic immunity, the acute and transient immune changes during each exercise bout may have improved overall immune-surveillance, decreasing the risk of illness. A 10-month exercise training study showed that the antibody titer response to the influenza vaccine was increased in elderly adults who had undergone training as compared with sedentary controls. Those who exercised trained at 65% to 75% heart rate reserve, 25 to 30 minutes, 3 days per week (Xiaoyun

Su MD, Jiping He MD et al, 2022).

Result of (Smart, T. F. F., et all 2022) have reported that Resistance aerobic exercise training improves both cardiorespiratory fitness and muscle strength for lower body in elderly people and this intervention training improves multiple measures of cardiorespiratory fitness within a 24-week intervention in elderly people

Aerobic exercise training (AET) has been used to improve Cardiorespiratory fitness (CRF) is an important aspect of health for ageing process, this form of training fails to improve body composition, and Immune system, resistance exercise training (RET) is the most employed modality to improve both muscle mass and function (Boileau RA, McAuley E, Demetriou Det al 1999)

Investigators from a recent study on intervention resistance aerobic exercise training showed no effect on resting immune parameters It has not been determined how the elderly respond to a single bout of resistance exercise before and after a period of resistance training. Acute resistance exercise has been reported to increase serum cortisol and epinephrine **(Crosier**, J. L., G. Camus, G 2016) which are potential modulators of the immune system. In addition, moderate-intensity exercise has been reported to suppress post-exercise immune responses (Crist, D. M., L. T 1989) Therefore, we hypothesized that acute resistance training would result in a similar down-regulation of immune function in this population. Because the initiation of a rigorous resistance training program may prove to be a significant stressor for elderly subjects, the potential positive consequences of strength development could be compromised by impaired host defense. The purpose of this investigation was to examine the effects of Combination of Resistance training& Aerobic Training program for 3 month on selected phenotypic and functional indexes of the immune system in elderly women (Keating CJ, Párraga Montilla J, Latorre Román P, Moreno del Castillo R2020).

Aim of this study:

Aim of this study is to examine effects of Intervention between Resistance& Aerobic training (IRAT) program for 12 weeks on:-

- Body composition (BMI, FFM, FM, BFM).
- muscle strength (Leg Extension, Leg Curl, Planter, Dorsiflexion, Hip Flexion, Hip Extension, Abduction, Adduction).
- Components of Blood Cells for Immune system (Hemoglobin, Wight Blood Cells, Red Blood Cells, Platelets, Lymphocyte, Monocytes, Neutrophil)

Hypotheses of this study:

- There are statistically significant differences between means of pre and post measurements of experimental group in Body composition (BMI, FFM, FM, BFM) for Post measurements in elderly women.
- There are statistically significant differences between means of pre and post measurements of experimental group in muscle strength for Post measurements in elderly women.
- There are statistically significant differences between means of pre and post measurements of experimental group in Components of Blood Cells for Immune system (Hemoglobin, Wight Blood Cells, Red Blood Cells, Platelets, Lymphocyte, Monocytes, Neutrophil) for Post measurements in elderly women.

Methodology:

Research method:

A quantitative experimental method (exercise treatment) of one group, (pre-post) tests were applied in current study.

Sample of research:

10 female volunteers aged 60-70 years participated from members of police Club (elgizera) in this study (general charactistics of test participants and completed the study protocol including (Immunological tests, function abilities tests and resistance aerobic training program).

Study design

Potential subjects were asked to complete a medical history and exercise questionnaire and return it to researcher. Other exclusion criteria were arthritis , being bedridden within 12 week of the study, central or peripheral nervous system disorders, stroke, use of antidepressant medications, acute or chronic infection, major affective disorder, human immunodeficiency virus infection or autoimmune disorders, metabolic disorders, oral steroid use, cigarette or smokeless use, regular resistance & aerobic training within previous at least 3 month, surgery within the previous 3 month, and caffeine consumption in excess of four cups of coffee per day.

Before the study, a lower extremity musculoskeletal exam was performed to identify musculoskeletal or flexibility limitations that would interfere with the completion of the training protocol. Each subject was also asked to perform a ‘‘get-up and go’’ test, which involved rising from a chair, walking 15 m, turning, and returning to sit in the chair. Each subjects who were unable to complete this task were excluded from participation.

Testing procedure

Pre-measurement was conducted from Saturday 01/04/2023 to Monday 03/04/2023 and Training program (IRAT) was applied from 05/04/2023 to 05/07/2023, post-measurement was conducted from Saturday 08/07/2023 to Saturday 12/08/2023.

Participants were practicing moderate exercise with frequency 3 times per week for at least 60 minutes each session, 5 to 15 min of **aerobic training** intensity of aerobic training (bike-treadmill), **Resistance training from** 15 to 30 minute (50-75% of 1RM). The program was changed every 2 weeks to avoid adaptation of the body and therefore will have no effect on the body, taking into consideration the use of large muscles in the body, first to deliver blood to the small muscles faster.

Data Collection

Tools & Equipments:

- InBody 230 for measuring Body composition (Appendix 5)
- Blood sample collecting (a needle, a 12-ml syringe, evacuated tubes: the first a plain tube, the second containing EDTA, the third containing acid citrate-dextrose, and the fourth containing preservative-free heparin. Ice for blood plain tube keeping, (EDTA). (Appendix 6)
- **Equipments and tools used in the application of the physical activity program:-**(Inner and outer thigh, Outer thigh Leg press, Calf raises , Leg extension Butterfly, Lateral Pull Down, Lateral rowing).

Physiological tests and measurements

Body composition

All Body composition measurements (weight, skeletal muscle mass, Body fat mass, Total body water, Fat free mass, Body mass index, Percent body fat, Waist-hip ratio, Basal metabolic ratio) were performed by the same investigator throughout the study period before and after the intervention, (InBody 230, Biospace Co Ldt; Soul Korea). Subjects were barefoot and in light clothing performing the measurement.

Blood sample treatment and analysis

All blood samples were obtained from an antecubital vein by using a needle and a 12-ml syringe, and blood was dispensed into four evacuated tubes: the first a plain tube, the second containing EDTA, the third containing acid citrate-dextrose, and the fourth containing preservative-free heparin. Blood in the plain tube was kept on ice, allowed to clot. Blood samples (EDTA) for complete blood count and differential were refrigerated until analyzed on the same day. Lymphocyte proliferation and natural killer cell activity [natural cell-mediated cytotoxicity (NCMC)] assays were performed on heparinized blood (room temperature) within 4 h of sampling. Mononuclear cell populations were determined on acid citrate-dextrose samples stained and fixed within 6 h of sampling (Lene Salimans, Keliane Liberman et al,2022).

Protocol of the physical activity program for elderly woman:

Each subject performed a one-repetition maximum (1RM) test for each exercise. The 1RM means lifted weight no more than one time, respectively, using Acceptable form means performing the leg-extension resistance exercise using the specified muscle groups without changes in body position to help apply force. Blood pressure and electrocardiogram were monitored during the 1RM testing.

Acclimation to Resistance training. Subjects were acclimated to the following resistance training exercises for 1 wk: leg extension, leg curl, ankle plantar flexion, dorsiflexion hip extension, hip flexion, hip adduction and hip abduction. Focus was placed on lower extremity exercises, each subject completed three sets of fifteen repetitions for each exercise at 50% of 1RM.

Resistance & Aerobic Training Program. Subjects assigned to completed an additional 12 week of IRAT for 3 month. A warm-up and stretching session similar to the one described above was performed before each training session. During the first week, the subjects performed three sets of fifteen repetitions for each exercise at 60% of 1RM. Then, the intensity was increased to 10% of 1 RM every two week until 75% . The 1RM was retested at the end of the 3 month.

Pre-and post-training responses to Resistance & Aerobic Training Program. The pre-training experimental trials were conducted following the acclimation week. Each IRAT subject performed three sets of leg extension, leg curl, plantar flexion, and dorsiflexion at 75% of 1 RM. The first and second set were eight repetitions, and the third set was performed to volitional fatigue. Leg extension was the final exercise of the session for all subjects. The subjects rested for at least 2min between each set. Post-training experimental trials were conducted the week following the completion of resistance training. Each IRAT subject performed the same number of repetitions at the same absolute workload that was used during the pre-training trial. As in the pre-training experimental trials.

Statistical analysis:

All statistical analyses were performed using the computer software system SPSS (PASW 2006). A dependent T-test (paired sample T-Test) was use to compare between the two measurements before and after training for experimental group. A significance level of $p<0.05$ was chosen. The level of significance was set at *P*, 0.05. was utilized to identify significant treatment or time effects when a significant T ratio was present. A test of simple main effects was used to detect differences when a significant interaction was found. Significant differences between pre and post for 1RM were determined. Descriptive statistics mean and standard deviation.

RESULTS

Random assignment to groups resulted in similar age, height, there were no differences in these data before vs. after training. According to body composition there were differences in these data before vs. after training in {weight, body mass index, and body fat. The descriptive data for the subjects can be found in Table 1, and the body composition can be found in Table 2. Strength changes with training. In the IRAT strength increased significantly for all exercises {leg extension, hip flexion, hip extension, and hip adduction}, as evidenced by the pre-to post-training 1RM differences. Lymphocyte phenotype number. There were significant exercise time, training time, or interaction effects for components of blood cell {Hemoglobin, Wight Blood Cells, Red Blood Cells, Platelets, Lymphocyte, Monocytes & Neutrophil}(Xiaoyun Su MD, Jiping He MD et al 2022).

Lymphocyte proliferative response to mitogen and NCMC. Lymphocyte proliferative responses to mitogen were assessed at both 10 and 40 μg/ml concentration of ConA. There were no significant group, exercise time, or interaction effects for lymphocyte proliferation at either dose of ConA. There was a significant training time effect for 10 μg/ml ConA , such that the week 10 values were higher for both RE and C groups compared with the first week values at Pre, Post, and 2h Post. There was not a similar significant training time effect for 40 μg/ml ConA.

There was a significant group-by-time interaction effect for NK expressed as percent cytotoxicity. Post NK values were significantly higher for IRAT subjects on first week and 12. The Post and NK values were significantly higher than baseline (Pre) on first week and week 12 for IRAT subjects. For NK was significantly higher than baseline (Pre) on first week and post in week 12.

There was a significant training time effect, i.e., the week 12 resting sample was higher for IRAT compared with the first week sample. There was also a significant time (exercise) effect, such that the post-muscles exercises value was higher at both first week and 12 week.

Table 1. Descriptive Statistics for All Variables physical characteristics (Age, Height& Weight), Body composition BMI, FFM, FM, BFM for iRA Training Before Program training by Elderly women

physical characteristics **Variables**	**N**	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Variance**	**Skewness**		**Kurtosis**	
Age	10	6.00	64.00	69.00	67.67	2.57	6.28	0.79	0.57	-0.65	1.12
Height	10	16.00	155.00	169.00	158.07	4.24	228.52	1.24	0.56	0.68	1.15
Body Weight (k.g)	10	21.30	63.60	84.90	76.77	6.51	42.39	-1.02	0.58	0.98	1.11
Body Mass Index(Kg/m2)	10	8.40	29.10	35.50	32.23	2.34	5.41	0.02	0.59	0.18	1.10
Fat Free Mass (Kg)	10	8.65	35.10	43.70	40.00	2.74	7.52	0.24	0.56	-1.06	1.11
Fat Mass (Kg)	10	19.85	25.20	42.00	35.45	5.16	25.64	-0.82	0.46	0.49	1.11
Body fat mass(kg)	10	9.93	35.10	43.00	42.47	3.25	10.43	-0.45	0.56	-1.06	1.11

Values are means ± SD; p values obtained from paired t-tests.

Tables 1 showed the descriptive statistics for All Variables physical characteristics (Age, Height & Weight), Body composition BMI, FFM, FM, BFM for IRA Training Before The 12 week Resistance & Aerobic training by in older women

Table 2. Showed the effect of IRAT on body composition before & after 12 week IRAT on all variables for body composition by Elderly women

Body Composition Variables	Pre		Post		Std. Error Mean	95% Confidence Interval of the Difference		T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Mean	Std. Deviation		Lower	Upper			
Body Weight (k.g)	76.77	5.51	68.07	3.65	0.89	5.76	10.64	9.62	14	0.00
Body Mass Index (Kg/m2)	32.23	2.33	28.27	1.58	0.28	3.35	4.57	13.86	14	0.00
Fat Free Mass (Kg)	40.00	0.71	44.80	0.83	0.35	2.42	4.98	11.61	14	0.00
Fat Mass (Kg)	35.45	1.33	29.00	1.05	0.54	3.28	6.61	10.08	14	0.00
Body fat mass(kg)	42.47	0.84	35.27	1.05	0.31	3.51	5.89	16.26	14	0.00

Values are means ± SD; p values obtained from paired t-tests. Significantly different from older group, p < 0:000;

Tables 2 showed that older women displayed a greater on BMI (p< 0:000) free fat mass (p <0:000), REE (p = 0:00), attain statistical significance (p = 0:00) relative to FFM changed in older women.

Table 3. Showed One-repetition maximum for IRA training before and after 12 week of resistance training on Strength muscles by Elderly women

Body Composition Variables		Pre		Post		Std. Error Mean	95% Confidence Interval of the Difference		T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Mean	Std. Deviation		Lower	Upper			
Leg Extension	**Kg**	14.55	1.52	20.3	2.48	0.48	-5.81	-4.78	-13.48	13	0.00
Leg Curl	**Kg**	8.40	1.62	15.4	2.09	0.74	-7.25	-4.18	-6.97	13	0.00
Planter	**Kg**	.89	2.36	8	0.92	0.52	-5.25	-1.97	-6.75	13	0.00
Dorsiflexion	**Kg**	7.50	1.16	12.6	1.75	0.57	-6.61	-5.13	-8.38	13	0.00
Hip Flexion	**Kg**	6.33	4.33	8.55	6.40	0.39	-4.91	-2.42	-5.99	13	0.00
Hip Extension	**Kg**	7.47	4.42	9.46	10.60	0.52	-3.15	-2.81	-9.07	13	0.00
Abduction	**Kg**	5.60	4.65	11.77	8.70	0.44	-3.06	-1.21	-9.51	13	0.00
Adduction	**Kg**	7.40	7.46	16.2	13.5	0.71	-8.33	-4.31	-9.73	13	0.00

Values are means ±SE from paired t-tests.

Table 3 showed *Significant difference Strength changes with training between pre- and post-after 3 month IRA training for all exercises p< 0.01{ Leg Extension, Leg Curl, Planter, Dorsiflexion, Hip Flexion, Hip Extension, Abduction, Adduction} Significantly different p <

0:05;

Table 4. Showed The Components of Blood Cells for Immune system for Experimental group before& after IRA Training 12 week by Elderly women

Immune Variables {Components of Blood Cells}	Pre		Post		Std. Error Mean	95% Confidence Interval of the Difference		T. Test	df	Sig. (2-tailed)
	Mean	Std. Deviation	Mean	Std. Deviation		Lower	Upper			
Hemoglobin {12.3- 15.7 g/dL}	11.03	0.69	13.33	0.9	0.33	-2.02	-0.58	-3.894	14	0.00
Wight Blood Cells {4.0-10.0x103/mm3}	3.02	1.31	6.51	2.09	0.43	-3.11	-1.27	-5.101	14	0.00
Red Blood Cells {4.0-5.2x106/mm3}	4.39	0.33	4.71	0.39	0.05	-0.43	-0.20	-5.976	14	0.00
Platelets {130-400x 103/mm3}	266.93	44.88	320.47	43.44	7.19	-56.96	-26.11	-5.77	14	0.00
Lymphocyte {16- 46%}	30.93	5.64	42.73	3.71	1.51	-14.04	-7.56	-7.16	14	0.00
Monocytes { 4- 11%}	3.58	0.54	6.13	1.85	0.44	-3.49	-1.62	-5.83	14	0.00
Neutrophil {45- 75%}	45.20	2.51	59.47	3.46	0.91	-12.22	-8.31	-11.25	14	0.00

Values are means ± SD; p values obtained from paired t-tests.

Table 4 showed *Significant difference on Immune Variables {Components of Blood Cells} changes with training between pre- and post-after 12 week IRA training for all Components of Blood Cells Significantly different p <

Discussion:

The main purpose of this study was to assess if performing intervention resistance aerobic training for 12 weeks (3 times/week) in a police club would be beneficial for female senior subjects from police club in terms of immunity (Hemoglobin, Wight Blood Cells, Red Blood Cells, Platelets, Lymphocyte, Monocytes and *Neutrophil*e), and if such an exercise intervention would possibly improve fitness and motor abilities such as body composition and muscular performance.

Within- group analysis demonstrated that in current study female senior subjects significantly improved their immunity and a reduction in incidence of illness. During each bout of moderate exercise, an enhanced recirculation of immunoglobulins, neutrophils, and natural killer cells occurs that persists for up to 3 hours post-exercise. This exercise induced surge in immune cells from the innate immune system is transient but improves overall surveillance against pathogens.

The primary results of this investigation suggest a robust, significant association between resistance exercise, upper and lower body strength improvement among older individuals. From a public health perspective, these findings confirm the value of full body resistive exercise for the prevention or treatment of age-related declines in muscle function, which may in turn serve as a safeguard against disablement.

In particular, we observed significant main effects (increases) for lower-body muscle strength (i.e. leg extension = 31.63 kg (29%); leg curl = 12.08 kg (33%)) following this resistance training intervention. As demonstrated from different authors such findings bear clinical significance, considering the exaggerated strength decline that occurs among sedentary individuals after the age of 50 years as well as the subsequent contribution of strength deficit to disability and movement impairment by (American College of Sports Medicine. 2019)

In an article of Chakravarti B, Abraham GM 2001 reported that the prescription of resistance exercise in older adults, the current analysis separated and examined the four most frequently tested immunity outcomes (i.e. Hemoglobin, Wight Blood Cells, Red Blood Cells, Platelets, Lymphocyte, Monocytes and *Neutrophil*e), and subjected each measure to individual meta-analytic synthesis and post hoc analysis. These measures were chosen due to the high frequency of demonstrating in the literature, and ultimately because the aggregate represents a superior indicator of whole body functionality, this is the first meta-analysis to synthesize data from full-body resistance training programs conducted on older men and women, and to report the main effects from multiple immunity outcomes.

Braith, R.W., Graves, J.E., Leggett, S.H 2005 found that lower body strength, immunity, and body composition overall functional task performance were improved after twelve weeks functional resistance aerobic training program. Although immunity was more enhanced by traditional resistance exercises, the older adult participants in their study were able to maintain task performance gains 3 months after program. This was attributed to greater specificity of training within the functional exercise group.

Also Charette, S. L., L. McEvoy et all 2017 demonstrated that higher intensity training was associated with greater strength improvement among older populations, as compared to low and moderate intensity training. In particular, training intensity ranged from approximately 40–90% of 1RM. Based on the a priori designation of low intensity (<60% 1RM), low/moderate intensity (60–69% 1RM), moderate/high intensity (70–79% 1RM), and high intensity (≥80% 1RM), the mean change in relative strength (i.e. percent from pre to post-intervention) for an incremental increase in intensity sub-group was nearly 5.5%.

There were a significant change from baseline in lymphocyte proliferative response immediately after resistance exercise in the present study. The lymphocyte proliferative data from the few resistance training studies that have been completed to date are conflicting. a significant suppression of lymphocyte proliferation immediately post-exercise.

Crist, D. M., L. T. Mackinnon, R. F 2001 found that Con A-stimulated lymphocyte proliferation was increased by 50% after exhaustive leg squat exercise compared with pre-exercise values; however, when these data were expressed. In our recent study comparing young and elderly women (78), there were no significant changes in lymphocyte proliferation post-exercise or during recovery. It would appear that additional research is required to elucidate the lymphocyte proliferative responses to resistance exercise

Aerobic training. Several studies of evidence support the link between resistance and aerobic training improved body composition leading to lowered obesity diseases rates: Survey data consistently support the common belief among fitness enthusiasts that regular aerobic exercise confers resistance against infection. The finding that all component for body composition reduced after 12 week aerobic & resistance training BMI, FFM, FM, BFM for IRA Training Before The 12 week aerobic training by in older women. The anther finding after 12 week the increase on strength muscles for all resistance exercise for { Leg Extension, Leg Curl, Planter, Dorsiflexion, Hip Flexion, Hip Extension, Abduction, Adduction} Significantly

different p < 0:01. Cannon, J. G., S. M. Meydani, R 2013.

There have been few studies completed to date that have examined the immune responses to endurance training in elderly subjects, and these findings have been Carroll, K. K., M. G. Flynn, P. F. Bodary, B. A 2015 suggested that , a second purpose of this investigation was to examine whether 12 week of resistance training would elicit changes in resting immune function, as measured by phenotypic and functional tests. In summary, acute resistance exercise did not negatively affect immune function either before or after a 12 week period of resistance training. Additionally, 3 months of resistance training, while eliciting substantial increases in muscular strength, did positively influence in the immune system in these elderly women.

Endurance exercise appears to have a suppressive influence on lymphocyte proliferative response to mitogen, with decreases reported during and immediately after exercise and either a return to baseline or continued suppression during the recovery period Beaufrere, B., Morio, B., 2000.

There were a significant changes from baseline in lymphocyte proliferative response immediately after resistance exercise in the present study. The lymphocyte proliferative data from the few resistance training studies that have been completed to date are conflicting. We previously Brochu, M., Savage, P., Lee, M., Dee, 2002 found a significant suppression of lymphocyte proliferation immediately post-exercise. found that Con A-stimulated lymphocyte proliferation was increased by 50% after exhaustive leg squat exercise compared with pre-exercise values; however, when these data were expressed. In our recent study comparing young and elderly women, there were no significant changes in lymphocyte proliferation post-exercise or during recovery. It would appear that additional research is required to elucidate the lymphocyte proliferative responses to resistance exercise.

In conclusion, this study suggests that intervention resistance aerobic training could serve as an alternative and potentially more creative and effective method for improving performance in older adults compared to more traditional exercises and could possibly be applied to people of all ages and physical abilities. In addition to the improved performance for muscle strength, immunity and body composition mentioned above it may be possible to maintain or enhance flexibility through supervised resistance exercise training due to the nature of the exercises (multi-joint with focus on full range of motion). This could prove useful for aging adults, which is a population that is most associated with poor or declining flexibility. In addition, many of the functional exercises used in this study could be performed in a variety of settings (fitness center or home).

Overall data indicate that a regularly performed intervention resistance aerobic training (IRAT) of moderate intensity lasting 12 weeks (performed 3 times a week) can enhance muscular strength, immunity and body composition, also functional parameters improving the quality of life in seniors.

References:

1. **American College of Sports Medicine.** 2019. Guidelines for Exercise Testing and Prescription (4th ed.). Philadelphia, PA: Lea & Febiger.
2. **Aw D, Silva AB, Palmer DB.** 2007. Immunosenescence: emerging challenges for an aging population. Immunology. 120:435-446.
3. **Baron, G. C., N. C. Klimas, M. A. Fischl, and M. A. Fletcher.** 1985. Decreased natural cell-mediated cytotoxicity per effector cell in acquired immunodeficiency syndrome. Diagn. Immunol. 3: 197– 204.
4. **Beaufrere, B., Morio, B.,** 2000. Fat and protein redistribution with aging: metabolic

considerations. Eur. J. Clin. Nutr. 54 (Suppl. 3), S48–S53.

5. **Berk, L. S., D. Nieman, S. A. Tan, S. Nehlsen-Cannarella, and J. Kramer.** Lymphocyte subset changes during acute maximal exercise (Abstract). *Med. Sci. Sports Exerc*. 18: 706, 1986.
6. **Berk, L. S., D. C. Nieman, W. S. Youngberg, K. Arabatzis, and M. Simpson-Westerberg.** The effect of long endurance running on natural killer cells in marathoners. *Med. Sci. Sports Exerc*. 22: 207–212, 1990.
7. **Braith**, R.W., Graves, J.E., Leggett, S.H., Pollock, M.L., 2005. Effect of training on the relationship between maximal and submaximal strength. Med. Sci. Sports Exerc. 25 (1), 132–138.
8. **Brochu**, M., Savage, P., Lee, M., Dee, J., Cress, M.E., Poehlman, E.T., et al., 2002. Effects of resistance training on physical function in older disabled women with coronary heart disease. J. Appl. Physiol. 92 (2), 672–678.
9. 5. **Brown, A. B., N. McCartney, and D. G. Sale.** Positive adaptations to weight-lifting training in the elderly. *J. Appl. Physiol*. 69: 1725–1733, 1990.
10. **Byrne**, H.K., Wilmore, J.H., 2001. The effects of a 20-week exercise training program on resting metabolic rate in previously sedentary, moderately obese women. Int. J. Sport Nutr. Exerc. Metab. 11 (1), 15–31.
11. **Campbell**, W.W., Crim, M.C., Young, V.R., Evans, W.J., 1994. Increased energy requirements and changes in body composition with resistance training in older adults. Am. J. Clin. Nutr. 60 (2), 167–175.
12. **Cannon**, J. G., S. M. Meydani, R. A. Fielding, M. A. Fiatarone, M. Meydani, M. Farhangmehr, S. F. Orencole, J. B. Blumberg, and W. J. Evans. Acute phase response in exercise. II. Association between vitamin E, cytokines, and muscle proteolysis. Am. J. Physiol. 260 (Regulatory Integrative Comp. Physiol. 29): R1235–R1240, 2013.
13. Carroll, K. K., M. G. Flynn, P. F. Bodary, B. A. Bushman, D. H. Choi, C. A.Weideman, T. M. Brickman, L. E. Bouillon, and P. G. Brolinson. Resistance training and immune function in young men (Abstract). Med. Sci. Sports Exerc. 27, Suppl. 5: S176, 2015
14. 34. **Chakravarti** B, Abraham GM. Aging and T-cell-mediated immunity. Mech aging Dev. 2001;108:183-206.
15. **Charette, S. L., L. McEvoy, G. Pyka, C. Snow-Harter, D. Guido, R. A. Wiswell, and R. Marcus.** Muscle hypertrophy response to resistance training in older women. *J. Appl. Physiol*. 70: 1912–1916, 2017.
16. **Chubak** J, McTiernan A, Sorensen B, et al. Moderate-intensity exercise reduces the incidence of colds among postmenopausal women. Am J Med. 2006;119:937-942.
17. **Crist**, D. M., L. T. Mackinnon, R. F. Thompson, H. A. Atterbom, and P. A. Egan. Physical exercise increases natural cellular-mediated tumor cytotoxicity in elderly women. Gerontology 35: 66–71, 1989.
18. **Crosier**, J. L., G. Camus, G. Deby-Dupont, R. Bertrand, C. Lhermerout, J. M. Crielaard, A. Juchm'es-Ferir, C. Deby, A. Albert, and M. Lamy. Myocellular enzyme leakage, polymorphonuclear neutrophil activation and delayed onset muscle soreness induced by eccentric exercise. Arch. Physiol. Biochem. 104: 322–329, 1996.
19. **Cohen** S. Keynote Presentation at the Eight International Congress of Behavioral Medicine: the Pittsburgh common cold studies: psychosocial predictors of susceptibility to respiratory infectious illness. Int J Behav Med. 2005;12:123-131.

20. ***Crist, D. M., L. T. Mackinnon, R. F. Thompson, H. A. Atterbom, and P. A. Egan.*** *Physical exercise increases natural cellular-mediated tumor cytotoxicity in elderly women. Gerontology 35: 66–71, 2001*
21. **Cullinen**, K., Caldwell, M., 1998. Weight training increases fat-free mass and strength in untrained young women. J. Am. Diet Assoc. 98 (4), 414–418.
22. **Defronzo**, R.A., 1979. Glucose intolerance and aging: evidence for tissue insensitivity to insulin. Diabetes 28 (12), 1095–1101.
23. **DeFronzo**, R.A., Tobin, J.D., Andres, R., 1979. Glucose clamp technique: a method for quantifying insulin secretion and resistance. Am. J. Physiol. 237 (3), E214–E223.
24. **Dvorak**, R.V., DeNino, W.F., Ades, P.A., Poehlman, E.T., 1999. Phenotypic characteristics associated with insulin resistance in metabolically obese but normal-weight young women. Diabetes 48 (11), 2210–2214.
25. **Fiatarone, M. A., M. A. Marks, E. C. Ryan, N. D. Meredith, C. N. Lipsitz, and W. J. Evans.** High-intensity strength training in nonagenarians. *JAMA* 263: 3029–3034, 1990.
26. ***Field****, C. J., R. Gougeon, and E. B. Marliss. Circulating mononuclear cell numbers and function during intense exercise. J. Appl. Physiol. 71: 1089–1097, 1991.*
27. **Fletcher**, M. A., G. C. Baron, M. R. Ashman, M. A. Fischl, and N. G. Klimas. Use of whole blood methods in assessment of immune parameters in immunodeficiency states. Diagn. Clin. Immunol. 5: 69–81, 1987.
28. **Folstein**, M. F., S. E. Folstein, and P. R. McHugh. ‘‘Minimental state.’’A practical method for grading the cognitive state of patients for the clinician. J. Psychiatr. Res. 12: 189–198, 1975.
29. **Frontera,W. R., C. N. Meredith, K. P. O’Reilly, H. Knuttgen, and W. J. Evans.** Strength conditioning in older men: skeletal muscle hypertrophy and improved function. *J. Appl. Physiol*. 64: 1038–1044, 1988.
30. ***Fry, R. W., A. R. Morton, G. P. M. Crawford, and D. Keast.*** *Cell numbers and in vitro responses of leucocytes and lymphocyte subpopulations following maximal exercise and interval training sessions of different intensities. Eur. J. Appl. Physiol. 64: 218–227, 1992.*
31. **Garcia**-Rubi, E., Starling, R.D., Tchernof, A., Matthews, D.E., Walston, J.D., Shuldiner, A.R., et al., 1998. Trp64Arg variant of the beta3- adrenoceptor and insulin resistance in obese postmenopausal women. **J. Clin.** Endocrinol. Metab. 83 (11), 4002–4005. Hughes, V.A., Fiatarone, M.A., Fielding,
32. **Lene Salimans, Keliane Liberman, Rose Njemini et all 2022: The effect of resistance exercise on the immune cell function in humans: A systematic review https://www.sciencedirect.com/science/article/abs/pii/S0531556522001309**
33. Maria Teresa Tomás, Alejandro Galán-Mercant, Elvis Alvarez Carnero[3], Beatriz Fernandes[1] 2018: Functional Capacity and Levels of Physical Activity in Aging: A 3-Year Follow-up Front. Med., 09 January 2018 | https://doi.org/10.3389/fmed.2017.00244
34. **Maha Sellami , Nicola Luigi Bragazzi , Baha Aboghaba, and Mohamed A. Elrayess2021: The Impact of Acute and Chronic Exercise on Immunoglobulins and Cytokines in Elderly: Insights From a Critical Review of the Literature https://www.frontiersin.org/articles/10.3389/fimmu.2021.631873/full**
35. **Smart, T. F. F., Doleman, B., Hatt, J., Paul, M., Toft, S., Lund, J. N., & Phillips, B. E. (2022). The role of resistance exercise training for improving cardiorespiratory fitness in healthy older** adults: a systematic review and meta-analysis. *Age and ageing*, *51*(6), afac143.

https://doi.org/10.1093/ageing/afac143

36 **Xiaoyun Su MD, Jiping He MD et all 2022: The effects of aerobic exercise combined with resistance training on inflammatory factors and heart rate variability in middle-aged and elderly women with type 2 diabetes mellitus.** https://onlinelibrary.wiley.com/doi/10.1111/anec.12996