Response of Mononuclear Cell to Moderate Exercise Training for Elderly Women

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Abstract:

Introduction: Several lines of evidence support the link between moderate Combination of Resistance & Aerobic Training (CRAT) and improved immunity leading to lowered infection rates. Moderate exercise training (aerobic training) causes favorable perturbations in immunity and a reduction in incidence of illness. During each bout of moderate exercise, an enhanced recirculation of mononuclear cell {CD3, CD4, CD8, CD14, CD19& CD56} in Women occurs that persists for up to 3 hours post-exercise. Rush of immune cells from the innate immune system which activated by exercising are temporary but boosts overall surveillance against pathogens. Practicing regular moderate exercise for three months can be effect on body weight decreasing and period of illness symptoms caused by obesity.

Study aim: To assess the Effects of Combination of Resistance & Aerobic Training (CRAT) on Changing of Mononuclear cell {CD3, CD4, CD8, CD14, CD19& CD56} & Body composition in Women.

Material and methods: one Experimental group of Women were engaged in this study, (15 women m.67.7± 2.7 yr.; range 65- 73). Obese women were engaged in training (CRAT) controlled in the same training session for trained 4-month, three times a week, 90 min per session, on non-consecutive days and exercised under the supervision of a personal trainer, to determine changes on Mononuclear cell {CD3, CD4, CD8, CD14, CD19& CD56}. Blood samples were obtained from all subjects {CRAT} pre at rest, post immediately after resistance exercise, before (week 0) and after week 16 after training.

Results: This study showed that Combination of Resistance & Aerobic Training (CRAT) increased Mononuclear cell {CD3, CD4, CD8, CD14, CD19 & CD56} and decreased body composition $P<0.01$).

Conclusions: Increased components of mononuclear cell and decreased body composition after Combination of Resistance& Aerobic Training (CRAT) suggest that immunity has been improved.

Key words: Combination of Resistance & Aerobic Training, Mononuclear cell & body composition, host defense.

Introduction"

Immune function is strongly related to with Lifestyle habits. Elderly people had lack of sleep and parry of physical activity, mental stress, poor nutrient and loss of energy and have all been related to impaired immune functions and raised risk of infection for example, the probability of getting diseased is directly related to the volume and period of stressful events

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and attitude. (15) During a 6-month period, for example, sick days is twice as considerable in high- compared with low-stress groups. (15) Sleep disruption also weaken immune function. For example, the individuals suffering from sustained sleep debt, their antibody response to the flu inoculation is reduced. (80)

Aging causes a serious dysregulation of many immune response components, most noticeably the T cell immune response. Interleukin (IL)-2 and interferon (IFN)-mediated T cell production substantially declines with aging. A declining ratio of Th1/Th2 is observed in elderly individuals because IFN-levels decline with the activity of T Helper 1 (Th1) cells and IL-4 and IL-10 levels rise with the activity of T Helper 2 (Th2) cells, respectively (2, 30).

Age-related decreases in myeloid dendritic cells (DCs) and natural killer (NK) and natural killer T (NKT) cell numbers are both associated with a deleterious immune response in the elderly (28). Decreased physical exercise is also linked to aging. Exercise can have substantial consequences on health, and there is growing evidence that these benefits may be caused in part by the way exercise affects immune system function (38). Short bursts of exercise have been shown to affect the quantity of circulating T cells and their capabilities (48, 100).

In male endurance-trained runners, Hinton et al. (40) found that after an interval running session of 151-min intervals at 95% VO2 max, there were significant changes in the composition of the total lymphocyte cultures: higher numbers of CD56+ NK cells and CD8+ T cells and lower numbers of T-helper cells (CD4+). After acute, intense exercise, there was an immediate decrease in T cell production of IL-2 and IFN- and mitogen-stimulated T cell proliferation (38). In real sense, it has been demonstrated that the amount of exercise is a key factor in determining whether the immune response is positively or negatively impacted (38,80). It has been demonstrated that little exercise improves T cell activity and lowers the risk of respiratory infections (25).

The long-term consequences of routine moderate exercise on immunological responses are still not fully understood, whereas the fact that several immune system components are known to undergo different alterations depending on the type and stage of exercise. also has been demonstrated to significantly improve a variety of biological parameters, including the ratio of CD4+ to CD8+, the number of CD4+/CD25+ regulatory T cells, HbA1c levels in type II diabetes, the Th1 response, and varicella-zoster virus-specific cell-mediated immunity. It has also been demonstrated to significantly improve natural killer cell numbers and activity in peripheral blood (30). To our experience, no research has been done to determine whether T Cell might help to improve the age-related T Helper 1&T Helper 2 (Th1/Th2) immunological imbalance.

Degradation of strength in elderly women has been specified as a significant factor contributing to a decline in independence and an identical heightened dependence on the health care system. (85) Strength performance of functional activities of daily living plays role in shortage of independence by the prevention of falls. (95) It has been proved that elderly may progress in work capacity and balance due to increased strength. (63) Consequently, such changes may reduce the occurrence of falls, protract independent functioning and result in a promoted quality of life. It had been demonstrated that resistance training has positive effects on musculoskeletal function in young adults, and recent findings have authenticated similar positive adaptations in the elderly (44, 49). Which has been reported to increase muscle size (15, 29, 44), by increasing muscular strength (29, 44, 51) and resting metabolic rate (53) and functional capacity. (44, 62) Fiatarone et al. (31) notified that a 174% increase in strength linked with a 9% increase in muscle size after only 8 weeks of resistance training in female nonagenarians.

Effect of exercise on host defense in young adults has been uncertain (6, 7, 35, 53, 45, and 95). while it has been determined that a moderate intensity of aerobic training intervention improved natural killer cell activity (NKCA) in adult women (61), but a single bout of intensive exercise may have a fugacious immunosuppressive effect.(7) For example, as increasing endurance exercise intensity, T-cell proliferative response decreased (35), there is potential that an acute bout of high intensity resistance training could evolve similar effects on host defense, particularly through the early days of training. Rincon et al. (71) recently reported that 16 week of exercise (90 min,3 days/wk) resulted in a decline in natural killer cell cytotoxic activity in six frail men deemed at risk for falls, compared with seven controls.

Immunosenescence associated with deficiency of immunity is slightly responsible for old age diseases. (95, 44) Elderly people are more susceptible to inoculation failure and autoimmune disorders, multiple infections, and cancers when compared with younger adults. Age related decline is generally obvious in T cell-dependent immune functions and is associated to thymus growth. (36, 15) Aging is an intricate process that basically leads to irreversible biological variations. While health habits can have a huge influence on life expectancy and quality of life, even in old age. (65) A recent and processing area of research is the linkage between particular lifestyle factors in certain, physical activity and diet and Immunosenescence. (91, 52)

In spite of studies on the importance of aerobic training on the immune systems of elderly people is just onset, finding from the few obtainable studies are intriguing and have latent for prevalent public health effect. Different cross-sectional studies have compared immune function in highly contingent and sedentary elderly (ie, ≥ 65 years) men and women. (78, 58) A study compared the immune

function on control group of 30 sedentary elderly women and 12 subjects mean (73 yrs) who were physically active for an average of 11 years, average VO2max of (31mL.kg-1.min-1), participant's demonstrated outstanding function of natural killer and T-lymphocytes in comparison with the 30 sedentary elderly women (58). On the other hand, study compared immune function in 17 elderly runners, who had exercised for about 17 years, and 19 elderly controls, and showed significantly higher T-lymphocyte function in the elderly runners.(78) Significantly higher rates of interleukin-2 (IL-2), interferon-g, and (IL-4) production from activated T-cells for elderly runners, when contrasted with control group, who practice aerobic exercise training for 2 to 6 months. (59)

Although chronic immunity did not change by practicing moderate exercise in elderly people compared to acute immune that have improved by 10 month exercising training at 65% to 75% heart rate reserve, 25 to 30 minutes, 3 days per week that reduce risk of illness, (45).

it has showed that Chronic endurance training has a significant effect of resting natural killer cell activity in elderly (Kostka T, Praczko K); however, a new study reported that resistance exercise training has no effect on resting immune parameters (43). It has not been confirmed how elderly people react to a single bout of before and after a period of resistance exercise training. Acute resistance exercise has been found that increase serum cortisol and epinephrine (60, 59), which are prospect modulators of the immune system. Further, high intensity of endurance exercise has been determined to inhibit post-exercise immune responses (17). Subsequently, we tried to investigate that acute resistance training would consequence in a comparable down regulation of immune function on the same sample. Because the beginning of a strict resistance training program may show to be a significant inconvenience for elderly people, the possible positive result of strength improvement could be affected by weakness of host defense. Aim of this study is to examine effects of Combination of Resistance training & Aerobic Training program for 4 months on Mononuclear cell {CD3, CD4, CD8, CD14, CD19& CD56} & Body composition in elderly women.

Hypotheses of this study:

- There are statistically significant differences between means of pre and post measurements of experimental group in Body composition 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 Mononuclear cell {CD3, CD4, CD8, CD14, CD19& CD56 for Post measurements in elderly women.

Methodology:

Subjects:

Subjects were recruited from Faculty of physical Education, surrounding communities and also from members of Alhly Club (Nasr City). one Experimental group of obese Women were engaged in this study, (15 women m.67.7± 2.7 yr.; range 65-

73). Potential subjects were asked to complete a medical history and exercise questionnaire and inclusion criteria were not suffering from any chronic disease, have no injuries and not smokers with any previously documented cardiovascular disease with any previously documented cardiovascular disease. To be overweight or obesity diagnostic.

After the initial medical examination, a detailed explanation session was held with all the details of the training program, the risks they may be exposed to during the application, the tests they will perform, and the benefits of the study on their health. In terms of sample selection, a complete medical history was obtained prior to participation. In addition, subjects who did not meet American College of Sports Medicine (1) criteria were excluded.

Some fitness tests and assessments were examined to large group of lower extremities musculoskeletal that may affect application of training program. "Get-up and go" and a one-repetition maximum (1RM) for elderly people test were performed with proper guidelines suitable with monitoring blood pressure and heart rate (Max 85%) during testing (41), so who was not having the ability to perform the full test was excluded from participation. subjects were engaged in training (CRAT) controlled in the same training session for trained 4-month (March to July of 2018), three times a week, 90 min per session, on non-consecutive days and exercised under the supervision of a personal trainer, to determine changes on Mononuclear cell {CD3, CD4, CD8, CD14, CD19& CD56}. Blood samples were obtained one from all subjects {CRAT} pre at rest, post immediately after resistance exercise, before (week 0) 10th of march 2018 and after week 16 after training on 15th of July 2018.

Subjects participated for a 1-wk to adapt to resistance training, after this week subjects continued to train for 16 weeks.

Resistance & Aerobic Training Program:

First, Subjects were adapted to some resistance exercises training for one week such as leg extension, leg curl, ankle plantar flexion, dorsiflexion hip extension, hip flexion, hip adduction and hip abduction. Concentrated was spotted on lower extremity exercises, to analyze gait and balance. Approximately 5–10 min of treadmill walking and a period of stretching preceded resistance exercise sessions. On Friday, Sunday and Tuesday during the acclimation week, each subject completed three sets of eight repetitions for each exercise at 50% of 1RM. On Friday of the acclimation week, the subjects' 1RM was assessed all exercise.

Subjects committed to complemented for a 16 week of intervened program (CRAT). Program consisted of a warm-up and was performed before each training session and stretching session. Subjects performed three times a week for each session 60 min per day for 4 months. Each exercise consisted of 3 sets of 8 repetitions at 60% of 1RM. Then,

every three-week intensity was increased to 10% of 1 RM until 80%. At the end of the fourth month 1RM was retested. (32, 22, 12)

Body composition:

Body Compassion was determined using (Body Compassion Instrument "In Body 230) with the volunteer in the fasting state and clothed in a physical gown. Height was measured using a tape measure fixed to the wall with the subject in stocking feet. Determination of fat mass and FFM was assessed using (Body Compassion InBody). In lab of the laboratory of faculty of Physical Education for women- Helwan University, FFM is defined herein as the mass of tissue representing soft tissue exclusively.

Data collection:

Blood samples were collected before and immediately after exercise test and obtained from an antecubital vein. Blood samples were distributed into four dispensed tubes (plain tube, EDTA, acid Citrate Dextrose, and preservative-free heparin) blood samples were kept in ice box until analysis later. Within 4 h of sampling, Lymphocyte proliferation and natural killer cell activity [natural cell-mediated cytotoxicity (NCMC)] assays were implemented on heparinized blood and within 6 h of sampling Mononuclear cell populations were fixed and determined on acid citrate-dextrose samples stained.

Statistical analysis:

Descriptive Statistics, the means and standard deviations (mean ± SD) of the parameters of the group was used and Paired- T- test were performed by using SPSS 10.0 to analyze the differences between before and after (CRAT) intervention on trained subjects over the 16-week, P value level was at 0.01. Significant differences between pre and post for 1RM were defined.

Results:

Fifteen of older women completed all sessions of (CRAT) program for 16 weeks. Mean age 67.7± 2.7 yr.; range 65- 73. Physical characteristics and body composition of subjects are shown in Table 1. Older women displayed a greater on BMI (p< 0:0001) free fat mass (p <0:0001), REE (p=0:047), attain statistical significance (p=0:04) relative to FFM changed in older women. There were significant differences in body composition variables found in (table 2). Muscular strength of legs increased significantly pre & post training 1RM (Table 3). In addition, aging has been shown to affect on some costimulatory molecules' expression such as Mononuclear cell (CD3, CD4, CD8, CD13, CD14, CD19& CD56) and natural killer cells showed significant differences P <.01 and functional immunological parameters (natural killer cell cytotoxic activity and lymphoproliferative response to Aerobic and resistance exercise Training program (Table 4).

Table (1)

Descriptive Statistics for All Variables physical characteristics (Age, Height& Weight), Body composition (BMI, FFM, FM, BFM) for CRA Training Before Program training by Elderly women. N=15

Variables	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
							Statistic	Std. Error	Statistic	Std. Error
Age	8.00	65.00	73.00	67.67	2.72	7.38	0.80	0.58	-0.66	1.12
Height	18.00	152.00	170.00	158.07	5.24	27.50	1.26	0.58	0.69	1.12
Weight (k.g)	22.30	63.60	85.90	77.77	6.51	42.39	-1.02	0.58	0.99	1.12
BMI (Kg/m2)	8.40	27.10	35.50	31.23	2.33	5.41	0.02	0.58	0.15	1.12
Fat Free Mass (Kg)	8.60	36.10	44.70	40.00	2.74	7.52	0.24	0.58	-1.06	1.12
Fat Mass (Kg)	19.80	24.20	44.00	35.45	5.16	26.64	-0.72	0.58	0.49	1.12
Body fat mass (kg)	9.90	36.10	46.00	41.47	3.24	10.52	-0.45	0.58	-1.06	1.12

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 CRA Training Before The 16-week Resistance & Aerobic training by in older women.

Table (2)

showed effect of CRAT on body composition before & after 16-week CRAT 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)	77.77	6.51	69.07	4.65	0.90	6.76	10.64	9.62	14	0.00a
Body Mass Index (Kg/m2)	31.23	2.33	27.27	1.58	0.29	3.35	4.57	13.86	14	0.00a
Fat Free Mass (Kg)	40.00	0.71	35.80	0.82	0.36	3.42	4.98	11.61	14	0.00a
Fat Mass (Kg)	35.45	1.33	30.00	1.05	0.54	4.29	6.61	10.08	14	0.00a
Body fat mass (kg)	41.47	0.84	36.27	1.05	0.32	4.52	5.89	16.26	14	0.00a

Values are means ± SD; p values obtained from paired t-tests. a Significantly different from older group, p < 0:0001.

Table (3)

Showed One-repetition maximum for CRAT training before and after 16 week of resistance training on muscles Strength by Elderly women.

Strength muscular Exercises	Pre		Post		Std. Error Mean	95% CI		T. Test	df	Sig. (2-tailed)
	M	SD	M	SD		Lower	Upper			
Leg Extension Kg	14.40	1.55	21.2	2.48	0.47	-7.81	-5.79	-14.47	14	0.00a
Leg Curl Kg	6.87	1.64	12.6	2.07	0.72	-7.28	-4.19	-7.96	14	0.00a
Planter Kg	3.87	2.35	8	0.99	0.53	-5.28	-2.99	-7.75	14	0.00a
Dorsiflexion Kg	6.20	1.15	11.6	1.84	0.58	-6.63	-4.17	-9.38	14	0.00a
Hip Flexion Kg	4.33	4.33	6.53	6.53	0.37	-2.99	-1.41	-5.98	14	0.00a
Hip Extension Kg	4.47	4.47	9.47	9.47	0.55	-6.18	-3.82	-9.06	14	0.00a
Abduction Kg	4.60	4.60	8.73	8.73	0.43	-5.07	-3.20	-9.50	14	0.00a
Adduction Kg	7.40	7.40	14.2	14.2	0.70	-8.30	-5.30	-9.74	14	0.00a

Values are means ±SE from paired t-tests.

Table 3 showed *Significant difference Strength changes with training between pre- and post-after 16 month CRA training for all exercises p< 0.01{ Leg Extension, Leg Curl, Planter, Dorsiflexion, Hip Flexion, Hip Extension, Abduction, Adduction}., a Significantly different p < 0:01;

Table (4)

Showed Number of CD3, CD4+ CD8, CD13+ CD14, CD19 and CD56 cells in Mononuclear cell blood CRAT trained before& after 16 week by Elderly women

Immune Variables {Mononuclear cell}	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			
CD^{3}	67.06	5.29	78.02	2.18	0.98	-13.06	-8.85	11.15	14	0.00a
CD^{4}	35.67	2.37	49.47	4.7	1.12	-16.20	-11.40	12.32	14	0.00a
CD^{8}	31.94	4.17	49.67	3.96	0.86	-19.56	-15.89	20.71	14	0.00a
CD^{13}	51.53	3.98	69.87	6.64	1.79	-22.18	-14.49	10.22	14	0.00a
CD^{14}	6.67	1.58	9.40	1.68	0.44	-3.68	-1.78	6.15	14	0.00a
CD^{19}	15.74	2.69	28.33	4.3	1.29	-15.36	-9.82	9.74	14	0.00a
CD^{56}	16.40	2.64	36.60	6.24	1.96	-24.41	-15.99	10.28	14	0.00a

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

Table 5 showed *Significant difference on Mononuclear cell changes with training between pre- and post-after 4 month CRA training for all Components of Mononuclear cell a Significantly different p < 0:01;

Discussion:

Several proof such as survey, animal, epidemiological, and randomized training data support the relation between moderate physical activity and boosted immunity leads to decrease infection rates. Surveys result consistently which support prevalent belief among fitness enthusiasts that regular exercise grants resistance against infection In survey studies, observed that 80% to 90% of regular exercisers as lower susceptible to viral diseases compared with sedentary elderly, but in general, they prop the results that moderate exercise reduces morbidity and mortality after pathogen vaccination, particularly when compared with prolonged and physical inactivity or intense exertion. Immunity disorders may occur due to Moderate exercise training and decreasing in prevalence of illness. Through each bout of moderate exercise, an enhanced reorganization of immunoglobulins, neutrophils, and natural killer cells appears that continues for up to 3 hours post exercise. This exercise stimulated flow in immune cells from the innate immune system is ephemeral but improves overall observation versus pathogens. 12 to 15 weeks of daily moderate exercise decreases weight body and obesity symptom (42, 44).

Excessive exercise is mostly correlated with post-exercise variations in percentage and number of blood lymphocyte phenotypes and restraint of natural killer cell activity and lymphocyte proliferative responds to mitogen (6, 63, 81, and 90). Because inhibition is oftentimes remarked after intense or prolonged endurance exercise, as we examined the effects of moderate intensity resistance exercise might trigger similar responses in functional examinations. In conclusion, combination between aerobic and resistance exercise training did not negatively affect immune function between pre- and post-after 4 month CRA Training.

Many findings have evidence on the relation between 4 month of (aerobic & resistance) training and enhanced body composition leading to reduction of obesity diseases rates: which determined on BMI, FFM, FM, and BFM in older women consequently has another effect on muscular resistance strength significantly different p < 0:01. (5, 7, 8, 9, 17)

we found that CD3, CD4+ CD8, CD13+ CD14, CD19 and CD56 cells in Mononuclear cell numbers have changed after an acute bout of resistance exercise and this result agree with the study of Carroll, K. K., et al. 1995 (15). On the other hand, Neiman et al.1995 (59) found that there was a ephemeral reproduction in cell number subsequent intense resistance exercise training in young males. Moreover, several evidence show between result of this study and other examination that investigates immune responses to resistance exercise (15, 59, and 96) was a fleeting excess elderly woman

previously, has been showed that after resistance exercise inhibition of NK by two groups of applied on young males (15, 59). Because it reported that elderly has weakness in cellular immune function (60), so, there were a concern for negative influence on the immune system due to the acute bout of resistance exercise. (13, 14, 17, 10, 24, 18)

There have been few equivocal findings studies that have tested the immune responses to endurance training in elderly people. (20, 60, 97). Showed that acute resistance exercise training did not negatively affect immune function either before or after a 4 month. in addition to that 16 week of resistance training essential positively affect on increases muscular strength and in the immune system in these elderly women. (98, 99, 1)

after intense resistance exercise in young males has been observed both NK and lymphocyte proliferative responses to mitogen have been shown significantly lower below standard levels for after 2h of recovery. (15, 60), and on other study for 1–6 h of recovery from extensive endurance exercise (33, 44).

Nieman et al. Have informed that women performed intensity resistance of exercise training program higher than men in number of sets and repetitions and who had muscular insufficiency while exercised on a single resistance exercise. However, there are other differences between immune findings of two studies (61) and may be refers to be a result of different methodologies for assessing Natural Killer during high intensity load or concentrate on a single exercise post exercise inhibition of NK in young males. (98, 99)

Aerobic exercise seems to have a repressive impact on lymphocyte proliferative reduction response to mitogen during post exercise which could back to standard or persisted suppression during recovery (32, 51, 61, and 3). Aerobic exercise seems to have a repressive impact on lymphocyte proliferative reduction response to mitogen during post exercise which could back to standard or persisted suppression during recovery (32, 51, 61, and 3). however, we found that post resistance exercise training there were changes in lymphocyte proliferative response in increasing leg strength which incompatible with outcomes of other studies (9, 41, 97). We previously found (15) a significant suppression of lymphocyte proliferation immediately post-exercise.

due to suppression and reduction of natural killer cells during recovery after resistance exercise, Nieman et al. suggested to Prostaglandin (PGE2) production peripheral blood mononuclear cells (PBMC) and activated monocytes. (61) which supported Rall et al. (71) who reported that there were no changes by 12 weeks of resistance training either in isokinetic concentric or eccentric exercise in young elderly. (20) And that conflicting with findings of Cannon et al. (14), which referred the muscular breakdown which happens during eccentric of resistance exercise training stimulated PBMC to produce

PGE2 by improved the ability of phytohemagglutinin.

Vagner Raso et al., showed that increased muscle strength in 44% and 48% after 6 and 12 months, and that what our finding support on the other hand, have been reported that there but it does not change immune phenotypic and functional parameters of previously sedentary, clinically healthy, elderly women which conflicts with our result that found changes pre and post CART program in immunological parameters (CD3, CD4, CD8, CD14, CD19& CD56) response , This difference may be due to the change in the application of the program between the two studies from 3 month to 4 months (92)

Rall et al. (71) Rall et al reported that have no significant alter of chronic (12week) of resistance exercise training on lymphocyte subsets or lymphocyte proliferative response to mitogen. The fact that our week 16 CRAT values for lymphocyte proliferation were higher than week 0 values suggests that a seasonal variation was responsible for these differences. Rall et al. did not measure NK, and there are no other published studies with which to compare our finding that resting NK was changed after 16 wk. of resistance training. (15, 31)

Impact of TC exercise on T lymphocytes and their subgroups, there were no discernible intergroup differences between the CON and TC groups in the percentages of T lymphocytes (CD3+) and their subsets (CD4+ and CD8+) in the peripheral blood at the beginning of the exercise program. While there was no major change in the percentages of CD3+ or CD8+ T cells, a six-month Tai Chi exercise program significantly enhanced the proportion of CD4+ T (Th) lymphocytes and the CD4+:CD8+ ratio. By comparing the CD4+:CD8+ ratio at six months of TC exercise to the ratio at the beginning, there was a significant difference within the TC exercise group. The percentage of CD4+ T cells significantly differed at 6 months following TC exercise compared to 4 months prior. However, throughout the whole trial period, the ratios of T cells (CD3+) and their subsets (CD4+ and CD8+) in the CON group did not show any alterations (onset; 4 months; and 6 months). The percentage of CD4+ T cells that produce either IFN-γ or IL-4 changed in different ways in the two groups of people, the control group and the group who exercised. The percentage of IFN-γ-producing CD4+ T cells was higher in the group who exercised at the beginning of the study, but this difference didn't last. The percentage of IL-4-producing CD4+ T cells was higher in the group who exercised at 4- and 6-month intervals, but this difference didn't last either. (50)

After exercise, there was an increase in the percentage and number of naïve (KLRG1-/CD57-) and senescent (KLRG1+/CD57+) CD8+ T-cells. However, only an increase in the number of naïve CD4+ T-cells was observed. The number of CD4+ T-cells expressing glucose transporter 4, GLUT4, increased by 53% after exercise. Additionally, the percentage of CD8+ T-cells expressing fatty acid

translocase, CD36 and CD4+ T-cells expressing hexokinase 1, HK1, and hexokinase 2, HK2, decreased after exercise. A significant 55% decrease in the number of CD4+HK1+ T-cells was also observed after the exercise bout. Similarly, the percentage CD8+ T-cells expressing HK1 also decreased after exercise. However, sex had no effect on nutrient sensors. CMV seropositivity was associated with a greater percentage and number of senescent CD4+ T-cells after exercise compared to their CMV seronegative counterparts. (50)

Theall B, et al 2021 found the total number of CD4+ T cells expressing CD36 post-exercise was not statistically different from pre-exercise values, despite a favorable correlation between exercise-induced CD4+ T-cell activation and increased expression of the fatty acid transporter CD36. Rather, our results revealed a frequent and significant correlation between the absolute numbers of CD4+ and CD8+ T-cells expressing activation markers and the absolute numbers of CD4+ and CD8+ T-cells expressing glucose transporters. Despite being preliminary, these results may point to a compensatory process in which stimulated CD4+ T cells. (86)

T-cells have been used to study cellular activation in reaction to mitogen-induced stimulation. (Motamedi et al., 2016; Reddy et al., 2004). The activation reaction to exercise, however, is poorly understood. (55, 72)

Following exercise, studies have shown a rise in very early activated (CD3+CD69+) and early (CD3+CD25+) CD4+ and CD8+ T-cells. (Curran et al., 2019; Morabito et al., 2016). These findings are supported and expanded upon by the current data, which demonstrate a spike in late-activated CD4+CD71+ and CD8+CD71+ T-cells. (21, 54)

The short- and long-term impacts of exercise on immune cell mitochondrial bioenergetics are gaining attention. (Busquets-Cortes et al., 2017; Rosa et al.,2021). (11, 74)

In conclusion, many studies demonstrated different effects of exercise on the immune system such as T-cell proliferative capacity, increased neutrophil function, and NK cell cytotoxic activity. Probably due to application of different protocol, methodology, age, sex, and testing procedure. The present study demonstrates our study show that 16 week of moderate intensity of resistance and aerobic exercise training can reduce the level of obesity symptoms and immune function in 67-to73-yr-old women. In addition, immune responses induced particularly after exercise also improve strength. So, we recommend that the role of exercise training may have in preventing immunosenescence and disease or improving health span.

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