

Efeitos do treinamento de exercício aeróbico sobre os níveis séricos de HDL colesterol

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A Meta-analysis

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Background: Aerobic exercise is believed to reduce the risk of cardiovascular disease partially through increasing serum levels of high-density lipoprotein cholesterol (HDL-C). However, this effect varies considerably among exercise intervention studies.

Methods: Electronic database searches of MEDLINE (1966-2005) for randomized controlled trials that examined the effect of exercise training on HDL-C level.

Results: Twenty-five articles were included. Mean net change in HDL-C level was statistically significant but modest (2.53 mg/dL [0.065 mmol/L]; $P < .001$). Minimal weekly exercise volume for increasing HDL-C level was estimated to be 900 kcal of energy expenditure per week or 120 minutes of exercise per week. Univariate regression analysis indicated that every 10-minute prolongation of exercise per session was associated with an approximately 1.4-mg/dL (0.036-mmol/L) increase in HDL-C level. In contrast, there was no significant asso-

ciation between exercise frequency or intensity. Multiple meta-regression analyses demonstrated that subjects with a body mass index (calculated as weight in kilograms divided by height in meters squared) less than 28 and total cholesterol level of 220 mg/dL [5.7 mmol/L] or more experienced an approximately 2.1-mg/dL (0.054-mmol/L) larger increase in HDL-C level than those with a body mass index of 28 or more and total cholesterol level less than 220 mg/dL (5.7 mmol/L).

Conclusions: Regular aerobic exercise modestly increases HDL-C level. There appears to exist a minimum exercise volume for a significant increase in HDL-C level. Exercise duration per session was the most important element of an exercise prescription. Exercise was more effective in subjects with initially high total cholesterol levels or low body mass index.

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Introdução

- Doença Cardiovascular x Morte
- Baixos níveis de HDL como fator de risco para Doença Cardiovascular
- Exercício Aeróbico x Níveis de HDL
- Variáveis do exercício x Resultados

Objetivo

1. Estimar o mínimo de exercício necessário para aumentar os níveis de HDL
2. Determinar quais as características de exercícios mais efetivas para este aumento.
3. Investigar quais as características dos sujeitos que mais se beneficiam.

Métodos

Critérios de Inclusão

1. Treinamento aeróbico em adultos (>20 anos)
2. HDL-C (com medidas no período de base e no fim da intervenção).
3. Período de intervenção de pelo menos 8 semanas
4. Ter um grupo exercício e outro controle sem exercício.
5. Exercício Aeróbio definido como rítmico, com grandes grupos musculares envolvidos e pelo menos 15 minutos de duração.

Métodos

Critérios de Exclusão

1. Outras intervenções associadas como por exemplo dieta.
2. Estudos com específicos problemas médicos, como histórico de câncer, tratamento de hemodiálise, e doença da artéria coronária.

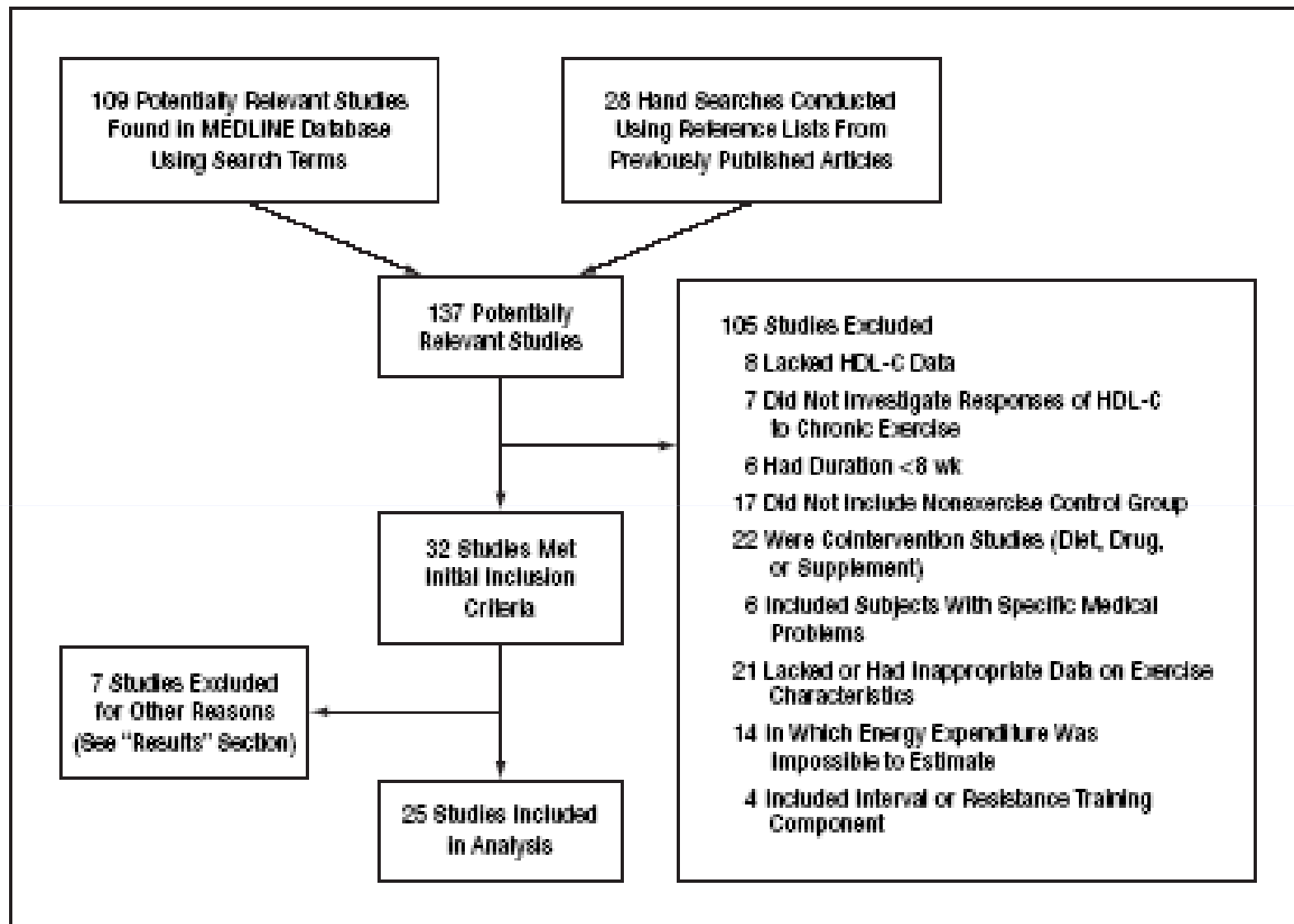


Figure 1. Selection of articles on randomized controlled trials for meta-analysis of exercise and its effects on high-density lipoprotein cholesterol (HDL-C) level.

Métodos

- Intensidade Relativa de Exercício:

Freqüência Cardíaca de Reserva ou pela % da Freqüência Cardíaca máxima.

- Intensidade Absoluta de Exercício :

Calculada multiplicando a intensidade relativa, % do VO₂ pico ou VO₂ máximo, pela capacidade aeróbica máxima.

- Volume de Exercício:

Por ambos, exercício total semanal e gasto calórico do exercício.

Calculado pela multiplicação da intensidade do exercício (Met= 0,0175) X a quantidade semanal X peso corporal.

Métodos

- Para investigar o volume mínimo de exercício prescrito sobre o qual se começaria a ter um aumento nos níveis de HDL-C, o estudo foi dividido em 4 intervalos por semana estimando o gasto energético (EE) ou exercício cumprindo.
- Um $P < 0,05$ foi considerado estatisticamente significante.

Resultados

- O tamanho da amostra variou entre 9 e 200 com um total de 1404 sujeitos (média de idade entre 23 e 75 anos).
- Média de intervenções de exercícios foi de 3,7 sessões por semana, com 40,5 minutos de duração.
- A média estimada entre a intensidade relativa e absoluta de exercício aeróbio foi de 64,8% da Capacidade Aeróbia máxima e 5,3 METs, respectivamente.
- O gasto calórico semanal estimado foi de 1.019 kcal/semana.

Table 1. Population Characteristics in Randomized Controlled Trials of Exercise Intervention and HDL-C

Source	Age, y	Sex, % M	Ex-n (Pre-Ex-n*)	C-n	HDL-C, mg/dL	TC, mg/dL	TG, mg/dL	BF, %	BMI	Max Cap†
Akdred et al, ³⁰ 1995	49	0	11 (13)	13	61	207	77	ND	ND	39.7
Baker et al, ⁴⁵ 1986	59	100	20 (23)	15	36	230	89	27.1	ND	30.6
Busby et al, ⁴⁶ 1985	50	0	12	12	50	173	71	ND	22.6	23.6
Cunningham et al, ⁴⁷ 1987	63	100	100 (113)	100	45	229	55	ND	26.2	30.0
Duncan et al, ³² 1991	20-40	0	16 (25)	10	54	180	78	29.3	23.8	30.4
			12 (26)	10	57	185	79	28.9	24.5	31.0
			18 (26)	10	53	184	90	29.4	23.8	31.1
Fahlman et al, ⁴⁸ 2002	75	0	15	15	44	182	128	ND	26.0	18.5
Grandjean et al, ⁴⁹ 1996	ND	0	20	17	56	203	133	28.1	ND	28.5
Houmard et al, ⁵⁰ 1994	48	100	13 (18)	7	35	200	155	28.2	30.4	29.5
Huttunen et al, ⁵¹ 1979	43	100	44 (50)	46	48	263	131	ND	ND	43.5
Juneau et al, ⁵² 1987	49	100	29 (30)	28	46	225	143	21.2	ND	32.5
		0	28 (30)	28	63	216	90	28.1	ND	26.2
Kokkinos et al, ⁵³ 1998	58	100	15 (17)	19	45	220	130	ND	30.6	21.0
Kraus et al, ⁵⁴ 2002	52	64	19	26	42	200	159	ND	29.1	29.5
	51	56	17	26	44	204	131	ND	29.2	28.9
	52	54	22	26	43	204	148	ND	29.2	28.3
Kukkonen-Harjula et al, ⁵⁵ 1998	41	100	53 (58)	55	50	205	103	24.1	25.5	40.0
Lindheim et al, ⁵⁶ 1994	50	0	25	20	63	217	82	ND	ND	27.5
Nieman et al, ⁵⁷ 2002	45	0	21	22	44	207	142	43.3	32.6	22.4
Ready et al, ⁵⁸ 1995	61	0	15 (19)	10	50	258	157	30.7	30.5	25.5
Santiago et al, ⁵⁹ 1995	31	0	16	11	64	184	73	28.2	24.2	32.8
Sopko et al, ⁶⁰ 1985	32	100	9	8	39	174	124	30.2	ND	30.0
Stensel et al, ³¹ 1993	51	100	42 (48)	23	54	220	93	29.2	25.2	35.7
Sunami et al, ⁶¹ 1999	67	50	20	20	51	205	96	21.1	22.4	30.2
Thomas et al, ⁶² 1984	18-32	100	5	6	39	175	82	13.8	ND	56.0
		100	7	6	40	171	83	12.8	ND	54.5
		0	9	6	44	173	81	21.8	ND	41.3
		0	11	6	40	167	80	27.9	ND	39.3
Thomas et al, ⁶³ 1985	23	100	11	8	49	161	ND	ND	ND	50.0
Wood et al, ⁶⁴ 1983	46	100	46 (48)	33	49	214	119	21.6	24.9	34.9
Woolf-May et al, ⁶⁵ 1998	57	100	10	10	55	221	114	ND	25.8	30.7
	54	0	6	5	78	222	115	ND	24.2	29.3
Woolf-May et al, ⁶⁶ 1999	55	100	5	4	45	224	121	ND	26.3	34.3
	51	0	13	8	62	224	122	ND	26.6	26.4

Abbreviations: BF, body fat; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); C-n, number in control group; Ex-n, number in exercise group; HDL-C, high-density lipoprotein cholesterol; Max Cap, maximal aerobic capacity, assessed by maximal or peak oxygen uptake; ND, no data; TC, total cholesterol; TG, triglycerides.

SI conversion factors: To convert HDL-C and TC to millimoles per liter, multiply by 0.0259; TG to millimoles per liter, multiply by 0.0113.

*Number in exercise group at preintervention.

†Estimated by energy expenditure and oxygen consumption during exercise; expressed as milliliters of oxygen per kilogram per minute.

Table 2. Exercise Intervention Characteristics in Randomized Controlled Trials of Exercise Intervention and HDL-C

Source	Exercise Intervention Characteristics							Information for Dietary Assessment	
	Weeks	Freq	Prescribed Exercise Intensity	D, min	Weekly EE, kcal	MET	Type of Exercise	Dietary Instruction*	Dietary Record†
Akdred et al ³⁰	12	6.1	Brisk walking; mean exercise intensity, 74% of HRmax	25	877	5.2	W/J	N	N
Baker et al ⁴⁵	20	3.0	65%-75% of HRR	48	1208	5.9	W/J	Y	Y
Busby et al ⁴⁶	12	3.0	70%-80% of HRmax	30	299	3.0	W/J	N	N
Cunningham et al, ⁴⁷	52	2.5	(≥60 maximal METs/10%) of HRR	32	578	5.9	W/J	N	N
Duncan et al ⁵²	24	5.0	Walking speed, 8.0 km/h	36	1294	6.7	W/J	Y	Y
	24	5.0	Walking speed, 6.4 km/h	45	1293	5.1	W/J	Y	Y
	24	5.0	Walking speed, 4.8 km/h	60	1166	3.6	W/J	Y	Y
Fahlman et al ⁴⁸	12	3.0	70% of HRR	50	599	3.5	W/J	Y	Y
Grandjean et al ⁴⁹	12	4.0	Progressively increased intensity (from 60%-70% of $\dot{V}O_{2max}$ to 70%-80% of $\dot{V}O_{2max}$)	40	1200	5.6	O	N	N
Houmard et al ⁵⁰	14	3.8	Progressively increased intensity (from 70%-80% of HRmax to 80%-85% of HRmax) and exercise duration (30 min/session to 45 min/session)	41‡	1245	4.9	W/J	N	N
Huttunen et al ⁵¹	16	3.0	Progressively increased intensity (from 40% of HRR to 66% of HRR) 15 min warming up; 10 min cooling down	38§	927	6.0	O	Y	N
Juneau et al ⁵²	24	5.0	Mean exercise intensity, 72% of HRmax	47	1725	5.3	W/J	Y	N
	24	5.0	Mean exercise intensity, 69% of HRmax	54	1175	3.9	W/J	Y	N
Kokkinos et al ⁵³	16	3.0	60%-80% of HRmax	44	462	2.1	C	N	N
Kraus et al ⁵⁴	26	3.4	40%-55% of $\dot{V}O_{2peak}$	52	920	3.3	O	Y	Y
	26	3.0	65%-80% of $\dot{V}O_{2peak}$	39	1003	5.6	O	Y	Y
	26	3.8	65%-80% of $\dot{V}O_{2peak}$	46	1423	5.4	O	Y	Y
Kukkonen-Harjula et al ⁵⁵	15	4.0	70% of $\dot{V}O_{2max}$	45	1742	7.6	W/J	Y	Y
Lindheim et al ⁵⁶	26	3.0	70% of HRmax	30	322	3.3	C	N	N
Nieman et al ⁵⁷	12	5.0	Progressively increased intensity (from 65%-70% of HRmax to 70%-80% of HRmax)	45	1151	3.3	W/J	N	N
Ready et al ⁵⁸	26	4.9	54% of HRR	54	1156	3.3	W/J	Y	Y
Santiago et al ⁵⁹	40	4.0	Treadmill walking, 4.8 km/session; mean exercise intensity, 72% of HRmax	50	875	3.9	W/J	N	Y
Sopko et al ⁶⁰	12	5.0	6 METs	67	3088	5.3	W/J	Y	Y
Stensel et al ⁶¹	52	2-3	Walking speed, 1.90 m/s	28	536	5.5	W/J	N	Y
Sunami et al ⁶¹	26	2-4	2-4 sessions/wk	60	570	3.4	C	Y	Y
Thomas et al ⁶²	12	3.0	75% of HRmax	42§	1330	7.8	W/J	N	N
	12	3.0	75% of HRmax	24§	664	7.7	W/J	N	N
	12	3.0	75% of HRmax	74§	1343	6.1	W/J	N	N
	12	3.0	75% of HRmax	37§	662	5.6	W/J	N	N
Thomas et al ⁶³	11	3.0	75%-85% of HRmax	42§	1415	8.9	W/J	N	N
Wood et al ⁶⁴	52	3-5	70%-85% of maximal aerobic capacity	28	1117	7.6	W/J	N	Y
Woolf-May et al ⁶⁵	18	6.0	68% of $\dot{V}O_{2max}$	23	828	4.2	W/J	N	N
	18	6.0	68% of $\dot{V}O_{2max}$	23	623	4.0	W/J	N	N
Woolf-May et al ⁶⁶	18	4.4	Approximately 70%-75% of $\dot{V}O_{2max}$	35	1340	6.0	W/J	Y	N
	18	4.4	Approximately 70%-75% of $\dot{V}O_{2max}$	35	884	4.4	W/J	Y	N

Abbreviations: C, cycling or bicycle ergometer; D, exercise duration per session; Freq, exercise frequency expressed as number of exercise sessions per week; HDL-C, high-density lipoprotein cholesterol; HRmax, maximal heart rate; HRR, heart rate reserve; MET, absolute exercise intensity in metabolic equivalents (1 MET corresponds to 3.5 mL of O_2 /kg per minute); N, no (ie, information was not provided); O, other type of aerobic training programs (eg, swimming, skiing, or use of an elliptical trainer); W/J, walking or jogging; weekly EE, estimated energy expenditure per week; $\dot{V}O_{2max}$, maximal oxygen uptake; $\dot{V}O_{2peak}$, peak oxygen uptake; Y, yes (ie, information was provided).

*Subjects were instructed to maintain regular eating habits or not to attempt to change body mass.

†Dietary intake was recorded before and after the intervention in the exercise and nonexercise groups.

‡Mean exercise duration per session during intervention.

§Estimated by energy expenditure and oxygen consumption during exercise.

||Assuming that 1 minute of warm-up corresponds to 0.5 minute of exercise training.

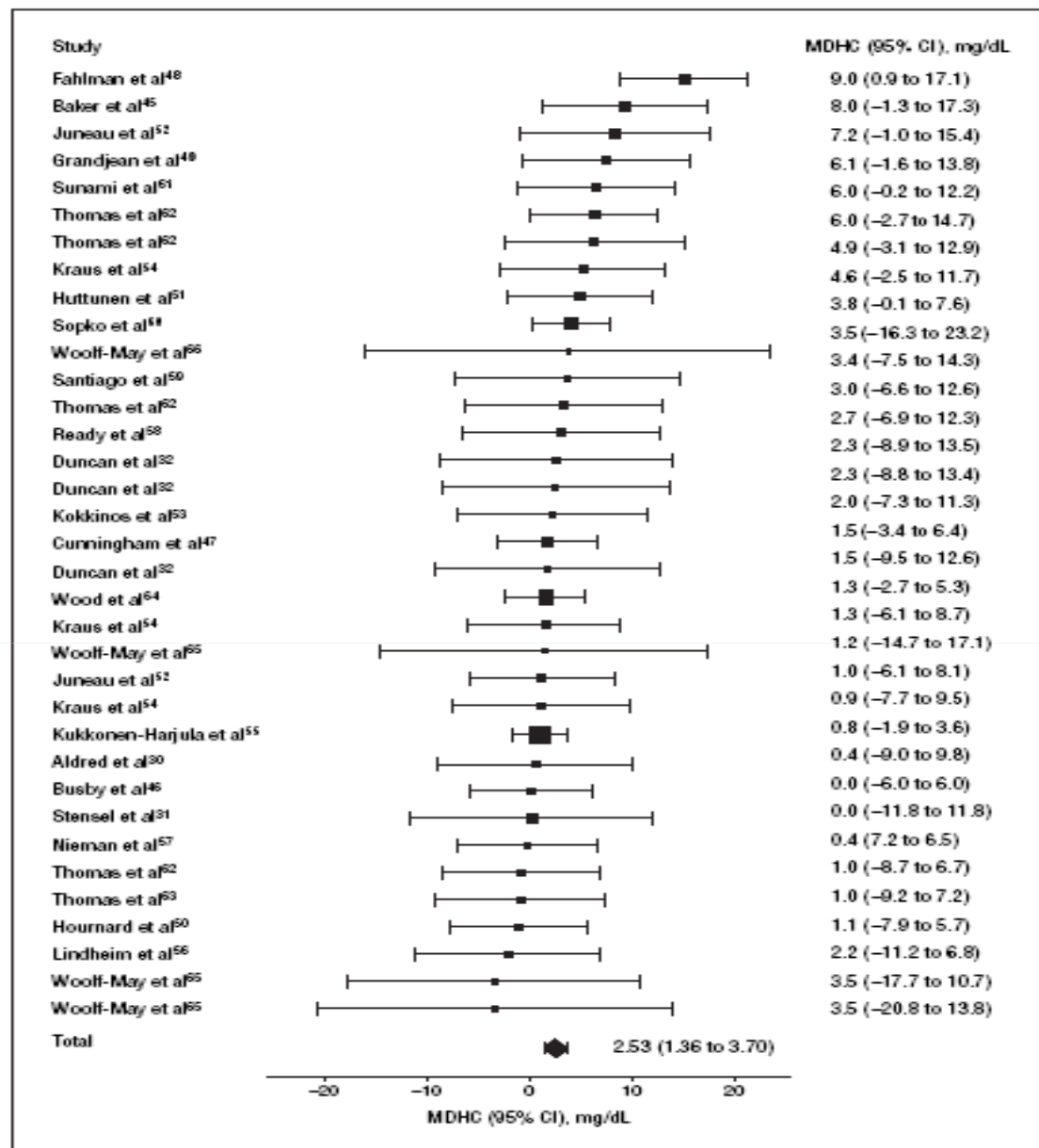


Figure 2. Mean differences in high-density lipoprotein cholesterol (HDL-C) change (MDHC) between exercise and nonexercise control groups in randomized controlled trials. The area of each square is proportional to the inverse of study variance in the analysis. Diamond indicates average net change in HDL-C level; horizontal lines indicate 95% confidence intervals (CIs). The χ^2 value for heterogeneity was 38.7 ($P = .31$) and the z score (ie, standardized mean difference) for overall effect was 4.23 ($P < .001$).

Table 3. Test for Pooled Mean Difference in HDL-C Change Between Exercise and Control Groups Through Exercise

Variable	No. of Strata (No. of Exercisers)	z Score* (P Value)		
		Unadjusted	Adjusted 1†	Adjusted 2‡
Weekly EE, kcal/wk				
≤600	5 (114)	0.73 (.47)	0.76 (.45)	0.94 (.35)
601-900	8 (174)	0.60 (.55)	0.66 (.51)	0.56 (.58)
901-1200	9 (228)	2.15 (.03)	2.23 (.03)	1.72 (.08)
>1200	12 (204)	2.94 (.003)	2.86 (.004)	3.13 (.002)
Weekly exercise length, min/wk				
≤90	5 (186)	0.17 (.86)	0.25 (.80)	0.17 (.86)
91-120	4 (118)	1.41 (.16)	1.49 (.14)	1.21 (.23)
121-150	7 (78)	1.96 (.05)	1.93 (.05)	1.92 (.06)
>150	18 (338)	3.09 (.002)	3.04 (.002)	3.19 (.001)

Resultados

Influência das características dos indivíduos na mudança nos níveis de HDL-C pelo treinamento:

2 tipos de Análise:

Modelo 1: Sem IMC

Modelo 2: Sem a % de Gordura

- Os modelos 1 e 2 mostram que indivíduos com altos níveis de colesterol total ou que eram menos obesos respondiam melhor ao treinamento.
- No modelo 2, em indivíduos com nível médio de colesterol total de 220 mg/dl ou melhor e média de IMC de 28 ou melhor, tinham uma elevação maior.

Comentários

- Em estudos anteriores foi observado que cada 1-mg/dl de aumento do HDL-C está associado a 2% e 3% na redução do risco cardiovascular. Se isto for aplicado aos achados deste estudo, isso resultaria em uma redução no risco cardiovascular de 5.1% em homens e 7,6% em mulheres.
- Existe uma patamar mínimo de exercício para obter aumento nos níveis de HDL-C.
- A intensidade de exercício não está associada, mas sim o volume .
- Os achados diferem da recomendação do American College Sport Medicine, que recomendam 30 minutos de atividade física moderada a maior parte dos dias da semana e seriam suficientes para promover a melhora nos níveis de HDL.-C.

Conclusão

- O aumento do nível médio de HDL-C foi modesto mas significativo.
- O volume mínimo do exercício no qual ocorre um significativo aumento no nível do HDL-C ocorreu em aproximadamente com um gasto energético semanal de 900 kcal ou no cumprimento de pelo menos 120 minutos de exercício semanal.
- Cada aumento de 10 minutos na duração do exercício correspondia a aproximadamente 1.4 mg/dL (0.036-mmol/L) de aumento líquido no nível do HDL-C.
- O exercício mostrou ser mais eficaz em indivíduos menos obesos (IMC de 28) e naqueles com um nível mais elevado de colesterol total (220 mg/dL [5.7 mmol/L]). O mecanismo para este efeito deve ser investigado no futuro.