表1 健康な人を対象とした自転車トレーニングのよる血糖値への影響

発表年	筆頭著者（文献番号）	国	対象者	群分け	人数	年齢	性別	介入方法	強度	時間	頻度	期間	アウトカム	介入前	介入後	全身持久力	介入前	介入後
2010	Finucane, F. M. (2)*	UK	healthy older people	介入群	48	71	男女	moderate intensity training (cycle ergometer)	50～70% W_{max}	60 min	3 per week	12 weeks	2-h post OGTT glucose (mmol/L)	6.9(5.9-8.4)	6.4(5.2-7.2)	load max (W)	144 ± 49	168 ± 50
				比較群	48		男女	control	–	–	–	–		7.0(5.5-8.6)	6.9(5.4-8.1)		159 ± 61	161 ± 54
2010	Hopkins, S. A. (3)	New Zealand	healthy nulliparous women	介入群	47	31±3	女性	moderate intensity training (cycle ergometer)	65% VO_{2max}	40 min	5 sessions per week	15 weeks	fasting glucose (mmol/L)	4.24(4.16-4.32)	4.35(4.23-4.47)	VO_{2peak} (ml/kg/min)	19.2 ± 3.7	20.0 ± 3.5
				比較群	37	29±4	女性	control	–	–	–	–		4.22(4.10-4.34)	4.30(4.19-4.41)		20.3 ± 4.0	18.7 ± 3.3
2014	Adamson, S. (4)*	UK	middle aged adults untrained individuals	介入群	8	43±8	男女(2/6)	high intensity training (cycle ergometer)	下記の負荷で全力ペダリング 男性：7.5%BW 女性：6.5%BW	6 sec×10 rep	16 sessions	8 weeks	fasting glucose (mmol/L)	4.6 ± 0.3	4.3 ± 0.2	VO_{2peak} (ml/kg/min)	27.2 ± 7.0	29.9 ± 7.0
				比較群	6	42±8	男女(1/5)	control	–	–	–	–		4.3 ± 0.5	4.2 ± 0.5		26.3 ± 4.0	23.5 ± 4.0
2015	Shepherd, S. O. (5)*	UK	healthy inactive	介入群	46	42±11	男女(15/31)	high-intensity interval training (cycle ergometer)	> 90% HR_{max}	< 25 min	3 sessions per week	10 weeks	fasting glucose (mmol/L)	5.3 ± 0.7	5.4 ± 0.9	VO_{2max} (ml/kg/min)	–	9% ↑
				比較群	44	43±11	男女(15/29)	moderate-intensity continuous training (cycle ergometer)	～70% HR_{max}	30-45 min	5 sessions per week	10 weeks		5.5 ± 0.9	5.6 ± 0.9		–	8% ↑
2016	Delvecchio, L. (6)	Australia	masters cyclists	介入群	10	54±10	男性	resistance training + sprint cycling training + endurance training (track cycling)	maximal effort (sprint cycling training)	6～30 sec ×1～3 rep	2 SCT sessions per week + 2 RT sessions + END	12 weeks	fasting glucose (mmol/L)	5.1 ± 0.3	5.0 ± 1.2	VO_{2peak} (ml/kg/min)	46.7 ± 9.3	45.6 ± 8.4
				比較群	7	49±5	男性	sprint cycling training + endurance training (track cycling)	maximal effort (sprint cycling training)	6～30 sec ×1～3 rep	2 SCT sessions per week + END	12 weeks		5.3 ± 0.7	4.6 ± 0.9		54.0 ± 10.2	51.9 ± 7.1
				比較群	10	57±9	男性	endurance training (track cycling)	normal	90 min	normal	12 weeks		5.1 ± 0.6	5.2 ± 0.8		36.9 ± 9.2	38.4 ± 6.9
2016	Peterman, J. E. (7)*	USA	sedentary commuters	介入群	20	42±12	男女(6/14)	pedelec commuting	–	40 min	3 days per week	4 weeks	2-h post OGTT glucose (mmol/L)	5.5 ± 1.2	5.0 ± 0.9	VO_{2max} (l/min)	2.2 ± 0.5	2.4 ± 0.5
				–	–	–	–	–	–	–	–	–		–	–		–	–

表2 疾患者を対象とした自転車トレーニングのよる血糖値への影響

発表年	筆頭著者	国	対象者	群分け	人数	年齢	性別	介入方法	強度	時間	頻度	期間	アウトカム	介入前	介入後	全身持久力	介入前	介入後
2013	Wenning, P. (8)	Germany	type 2 diabetes	介入群	14	61±8	男性	moderate intensity training (cycle ergometer)	HR at 2mmol/L LT	45 min	2 per week	12 weeks	fasting glucose (mg/dL)	155 ± 34	145 ± 17	load max (W)	159 ± 32	177 ± 41
				–	–	–	–	–	–	–	–	–		–	–		–	–
2017	Ruffino, J. S. (9)*	UK	type 2 diabetes	介入群	16	55±5	男性	reduced-exertion high-intensity interval training (cycle ergometer)	25 W or 0.65 Nm·kg lean mass−1	10 min	3 sessions per week	8 weeks	fasting glucose (mmol/L)	9.9 ± 3.0	9.2 ± 2.2	VO_{2max} (l/min)	2.6 ± 0.4	2.8 ± 0.5
				比較群	crossover design			walking	40–50% HRR	30 min	5 sessions per week	8 weeks		9.9 ± 2.8	9.7 ± 2.3		2.6 ± 0.5	2.7 ± 0.5
2018	Winding, K (10)*	Denmark	type 2 diabetes	介入群	13	54±6	男女(7/6)	high-intensity interval training (cycle ergometer)	95% W_{peak}	20 min	3 days per week	11 weeks		8.7 ± 1.9	8.0 ± 1.5		28.4 ± 6.1	34.2 ± 6.3
				介入群	12	58±8	男女(7/5)	moderate intensity training (cycle ergometer)	50% W_{peak}	40 min	3 days per week	11 weeks	fasting glucose (mmol/L)	8.0 ± 2.2	8.4 ± 2.6	VO_{2peak} (ml/kg/min)	27.8 ± 5.5	30.3 ± 7.5
				比較群	7	57±7	男女(5/2)	control	–	–	–	–		8.9 ± 2.4	9.4 ± 2.1		27.2 ± 9.1	26.3 ± 6.8
2009	Johnson, N. A. (11)	Australia	obese	介入群	12	49±2	男女	moderate intensity training (cycle ergometer)	50–70% VO_{2peak}	30–45 min	3 sessions per week	4 weeks	fasting glucose (mmol/L)	5.62 ± 0.29	5.63 ± 0.33	VO_{2peak} (ml/kg/min)	25.9 ± 1.4	29.2 ± 1.5
				比較群	7	47±4	男女	streching	–	30 min	3 sessions per week	4 weeks		6.11 ± 0.40	6.01 ± 0.29		25.0 ± 1.6	26.1 ± 1.7
2010	Whyte, L. J. (12)*	UK	sedentary overweight/obese	介入群	10	32±9	男性	sprint interval training (cycle ergometer)	0.065kg per kg of FFM	30 sec all-out sprint ×2–6 rep	6 sessions	2 weeks	fasting glucose (mmol/L)	5.51 ± 0.05	5.35 ± 0.11	VO_{2peak} (ml/kg/min)	32.8 ± 1.4	35.9 ± 1.6
				–	–	–	–	–	–	–	–	–		–	–		–	–
2016	Kong, Z. (13)	Macau	obese overweight	介入群	10	20±1	女性	high-intensity interval training (cycle ergometer)	90% VO_{2peak} (1.0 kg ～5%BW)	20min (8 sec +12 sec passive recovery) × 60 rep	20 sessions	5 weeks	fasting glucose (mmol/L)	4.5 ± 0.2	4.4 ± 0.4	VO_{2peak} (ml/kg/min)	34.1 ± 5.7	36.6 ± 6.6
				比較群	8	20±2	女性	moderate intensity training (cycle ergometer)	65% VO_{2peak}	40min	20 sessions	5 weeks		4.6 ± 0.5	4.4 ± 0.6		34.2 ± 4.3	38.2 ± 6.5
2018	Guadalupe-Grau, A. (14)*	Spain	metabolic syndrome	介入群	11	55±1	男女(8/3)	aerobic interval training (cycle ergometer)	70～90% HR_{max}	43 min	3 times per week	24 weeks	fasting glucose (mmol/L)	6.32 ± 0.81	6.32 ± 0.92	VO_{2peak} (ml/kg/min)	25.6 ± 7.2	27.9 ± 8.0
				–	–	–	–	–	–	–	–	–		–	–		–	–
2015	Goluchowska, A. (15)*	Poland	ischemic heart disease	介入群	63	58±7	男性	moderate interval training (cycle ergometer)	< resting HR+60–80% HRR	40 min (4 min cycling ×3 min active rest)	3 times a week	8 weeks	fasting glucose (mg/dL)	105 ± 33	103 ± 36	load peak (W)	91.4 ± 17.5	118.0 ± 18.5
				–	–	–	–	–	–	–	–	–		–	–		–	–

表3 健康な人を対象とした自転車トレーニングのよる血圧への影響

発表年	筆頭著者	国	対象者	群分け	人数	年齢	性別	介入方法	強度	時間	頻度	期間	アウトカム	介入前	介入後	全身持久力	介入前	介入後
1994	Arroll, B. (16)	New Zealand	adults	介入群	17	58	男女(10/7)	moderate intensity exercise (cycle ergometer)	50% VO_{2max}	40 min	4 consecutive days	4 days	SBP (mmHg)	142 ± 4	134 –	–	–	–
				比較群	crossover design			moderate intensity exercise (cycle ergometer)	50% VO_{2max}	10 min	4 consecutive days	4 days		147 ± 5	153 –		–	–
2008	de Geus, B. (17)	Belgium	untrained adults	介入群	74	43±5	男女	cycling to work	–	(2〜15km)	at least 3 times a week	1 year	SBP (mmHg)	129 ± 15	126 ± 14	VO_{2peak} (ml/kg/min)	31.5 ± 6	31.1 ± 7.5
				比較群	18	49±7	男女	current lifestyle	–	–	–	–		132 ± 17	128 ± 17		32.3 ± 5.5	29.9 ± 4.6
2010	Finucane, F. M. (2)*	UK	healthy older	介入群	48	71	男女	moderate intensity training (cycle ergometer)	50〜70% W_{max}	60 min	3 per week	12 weeks	SBP (mmHg)	139 ± 15	136 ± 13	load max (W)	144 ± 49	168 ± 50
				比較群	48		男女	control	–	–	–	–		134 ± 17	132 ± 19		159 ± 61	161 ± 54
2011	Moller, N. C. (18)	Denmark	adults	介入群	19	44±8	男女(13/6)	daily commuter cycling	self selected	minimum of 20 min	daily	8 weeks	SBP (mmHg)	133 ± 16	125 ± 13	VO_{2max} (ml/kg/min)	33.7 ± 6.6	38.6 ± 7.5
				比較群	23	46±9	男女(16/7)	no change in lifstyle	–	–	–	–		133 ± 13	128 ± 16		32.8 ± 7.9	34.5 ± 8.4
2013	Vogel, T. (19)	France	healthy older	介入群	71	66±7	男女(36/35)	intermittent work exercise training program (cycle ergometer)	4 min at first ventilatory threshold + 1 min at 90% maximal tolerated power	30 min (5 min×6)	twice a week	9 weeks	SBP (mmHg)	130 ± 15	120 ± 14	VO_{2peak} (ml/kg/min)	18.9 ± 5.9	22.6 ± 6.3
				–	–	–	–	–	–	–	–	–		–	–		–	–
2014	Adamson, S. (4)*	UK	middle aged adults untrained	介入群	8	43±8	男女(2/6)	high intensity training (cycle ergometer)	男性:7.5%BW 女性:6.5%BW	6 sec×10 rep	16 sessions	8 weeks	SBP (mmHg)	137 ± 11	133 ± 9	VO_{2peak} (ml/kg/min)	27.2 ± 7	29.9 ± 7
				比較群	6	42±8	男女(1/5)	control	–	–	–	–		128 ± 20	127 ± 11		26.3 ± 4	23.5 ± 4
2015	Shepherd, S. O. (5)*	UK	healthy inactive	介入群	46	42±11	男女(15/31)	high-intensity interval training (cycle ergometer)	> 90% HR_{max}	< 25 min	3 sessions per week	10 weeks	SBP (mmHg)	123 ± 11	123 ± 10	VO_{2max} (ml/kg/min)	–	9% ↑
				比較群	44	43±11	男女(15/29)	moderate-intensity continuous training (cycle ergometer)	〜70% HR_{max}	30-45 min	5 sessions per week	10 weeks		127 ± 14	123 ± 13		–	8% ↑
2016	Peterman, J. E. (7)*	USA	sedentary commuters	介入群	20	42±12	男女(6/14)	pedelec commuting	–	40 min	3 days per week	4 weeks	MAP (mmHg)	85 ± 11	83 ± 9	VO_{2max} (l/min)	2.21 ± 0.48	2.39 ± 0.52
				–	–	–	–	–	–	–	–	–		–	–		–	–
2017	Henriquez, S. (20)	Chile	postmenopausal women	介入群	21	58(54-59)	女性	moderate intensity exercise (cycle ergometer)	60-65% VO_{2max}	40 min	3 days per week	6 months	SBP	124 ± 16	118 ± 15	VO_{2peak} (ml/kg/min)	11.4 ± (9.9-12.8)	13.5 ± (9.4-15.3)
				比較群	21	55(52-61)	女性	circuit resistance training	20-30% 10RM	40 min	3 days per week	6 months		127 ± 16	120 ± 18		10.7 ± (8.8-13.9)	12.5 ± (11.0-16.1)

表4 疾患者を対象とした自転車トレーニングのよる血圧への影響

発表年	筆頭著者	国	対象者	群分け	人数	年齢	性別	介入方法	強度	時間	頻度	期間	アウトカム	介入前	介入後	全身持久力	介入前	介入後
2003	Katz-Leurer, M. (21)	Israel	patients with cerebrovascular accident at the subacute stage	介入群	46	62±11	男女	cycle ergometer training	< 60% HRR	10-20min 30 min	5 days a week 3 days a week	1-2 weeks 3-6 weeks	SBP	136 ± 15	130 ± 16	load max (W)	9 ± 13	25 ± 15
				比較群	46	65±11	男女	control	–	–	–	–		139 ± 25	136 ± 20		8 ± 11	13 ± 13
2015	Goluchowska, A. (15)*	Poland	ischemic heart disease	介入群	90	55±7	男性	moderate interval training (cycle ergometer)	< resting HR+60-80% HRR	40 min (4 min cycling ×3 min active rest)	3 times a week	8 weeks	SBP	130 ± 15	124 ± 18	load peak (W)	91 ± 17	118 ± 19
				–	–	–	–	–	–	–	–	–		–	–		–	–
2017	Ruffino, J. S. (9)*	UK	type 2 diabetes	介入群	16	55±5	男性	reduced-exertion high-intensity interval training (cycle ergometer)	25 W or 0.65 Nm·kg lean mass−1	10 min	3 sessions per week	8 weeks	SBP	132 ± 13	127 ± 10	VO_{2max} (l/min)	2.6 ± 0.4	2.8 ± 0.5
				比較群		crossover design		walking	40-50% HRR	30 min	5 sessions per week	8 weeks		132 ± 11	130 ± 17		2.6 ± 0.5	2.7 ± 0.5
2018	Winding, K (10)*	Denmark	type 2 diabetes	介入群	13	54±6	男女(7/6)	high-intensity interval training (cycle ergometer)	95% W_{peak}	20 min	3 days per week	11 weeks	SBP	140 ± 14	139 ± 16	VO_{2peak} (ml/kg/min)	28.4 ± 6.1	34.2 ± 6.3
				介入群	12	58±8	男女(7/5)	moderate intensity training (cycle ergometer)	50% W_{peak}	40 min	3 days per week	11 weeks		139 ± 7	143 ± 9		27.8 ± 5.5	30.3 ± 7.5
				比較群	7	57±7	男女(5/2)	control	–	–	–	–		–	–		27.2 ± 9.1	26.3 ± 6.8
2008	Brixius, K. (22)	Germany	overweight	介入群	7	59±1	男性	moderate intensity training (cycling)	at pulse 2-4mmol/L lactate	90 min	3 times per week	6 months	SBP	138 ± 6	126 ± 4	–	–	–
				介入群	7	59±1	男性	moderate intensity training (running)	at pulse 2-4mmol/L lactate	60 min	3 times per week	6 months		127 ± 2	126 ± 2		–	–
				比較群	7	52±2	男性	control	–	–	–	–		137 ± 5	126 ± 4		–	–
2010	Whyte, L. J. (12)*	UK	overweight/obese	介入群	10	32±9	男性	sprint interval training (cycle ergometer)	0.065kg per kg of FFM	30 sec all-out sprint ×2-6 rep	6 sessions	2 weeks	SBP	127 ± 3	121 ± 3	VO_{2peak} (ml/kg/min)	32.8 ± 1.4	35.9 ± 1.6
				–	–	–	–	–	–	–	–	–		–	–		–	–
2018	Guadalupe-Grau, A. (14)*	Spain	metabolic syndrome	介入群	11	55±1	男女(8/3)	aerobic interval training (cycle ergometer)	70〜90% HR_{max}	43 min	3 times per week	24 weeks	SBP	134 ± 18	121 ± 13	VO_{2peak} (ml/kg/min)	25.6 ± 7.2	27.9 ± 8.0
				–	–	–	–	–	–	–	–	–		–	–		–	–
2016	Alkatan, M. (23)	USA	patients with osteoarthritis	介入群	24	61±1	男女(2/22)	moderate intensity training (cycling)	45-50% HRR 60-70% HRR	20-30 min 40-45 min	3 days per week	12 weeks	SBP	126 ± 3	120 ± 2	–	–	–
				比較群	24	63?±1	男女(2/22)	moderate intensity training (swimming)	45-50% HRR 60-70% HRR	20-30 min 40-45 min	3 days per week	12 weeks		120 ± 3	120 ± 4		–	–
2015	Bardal, E. M. (24)	Norway	patients with fibromyalgia	fibromyalgia	16	54±7	女性	moderate intensity training (spining exercise)	〜75%HR_{max}	45-60 min	twice a week	12 weeks	SBP	125 ± 14	117 ± 14	VO_{2max} (l/min)	1.5 ± 0.3	1.5 ± 0.3
				healthy	19	52±9	女性	moderate intensity training (spining exercise)	〜75%HR_{max}	45-60 min	twice a week	12 weeks		117 ± 8	113 ± 11		1.6 ± 0.3	1.8 ± 0.3

表5 自転車通勤および自転車利用習慣と健康との関係

発表年	筆頭著者	国	アウトカム	対象者数	発症者数	年齢	性別	追跡年数	評価方法	リファレンス（非曝露）群の自転車利用レベル	比較（曝露）群の自転車利用レベル	RR	95%CI
2000	Andersen, L. B. (25)	Denmark	総死亡	30649 (6954)	8549 (2291)	20–90	男女	14.5	自己報告の自転車通勤時間	0 min/day	> 25 min/day	0.72	0.57–0.91
2007	Matthews, C. E. (27)	China	総死亡	67143	1091	40–70	女性	5.7	自己報告の自転車利用時間（通勤と通勤以外の用事に利用したものも含む）	0 MET-h/day	≥ 3.5 MET-h/day	0.66	0.40–1.07
			がん死亡	67143	537							0.63	0.20–2.01
			心血管死亡	67143	251							0.55	0.27–1.11
2011	Pronk, A. (28)	China	乳癌発症	73049	717	40–70	女性	9	自己報告の自転車利用時間（通勤と通勤以外の用事に利用したものも含む）	0 MET-h/day	≥ 3.0 MET-h/day	0.89	0.63–1.25
2013	Sahlqvist, S. (30)	UK	総死亡	13346	1670	40–79	男女	11.5	自己報告の自転車通勤時間	0 min/day	9 min/day	0.91	0.50–1.65
			がん死亡	13346	485							0.71	0.18–2.90
			心血管死亡	13346	700							0.68	0.28–1.66
2016	Rasmussen, M. G. (31)	Denmark	糖尿病発症	52513 (15063)	6779 (1327)	50–65	男女	14.2	自己報告の自転車通勤時間	0 min/day	> 20 min/day	0.70	0.57–0.85
2017	Celis-Morales, C. A. (26)	UK	総死亡	239265	1699	52	男女	5	自己報告の自転車通勤利用	No	Yes	0.59	0.42–0.83
			心血管死亡	254876	495							0.48	0.25–0.92
			心血管疾患発症	254151	1226							0.54	0.33–0.88
			がん死亡	246981	1123							0.60	0.40–0.90
			がん発症	243808	4302							0.55	0.44–0.69
2018	Rasmussen, M. G. (31)	Denmark	肥満発症	17675 (19736)	4173 (662)	50–65	男女	5	自己報告の追跡期間中の自転車利用習慣	No	Continuation	0.74	0.60–0.92