Table 1 Criteria to assess the risk of bias, from the Methods Guide for Effectiveness and Comparative Effectiveness Reviews

Risk of bias	Criterion	RCTs	NRCTs
Selection bias	Was the allocation sequence generated?	X	
	Was the allocation of treatment adequately concealed?	X	
	Were participants analysed within the groups they were originally assigned to?	X	X
	Did the study apply inclusion/exclusion criteria uniformly to all comparison groups?		X
	Did the strategy for recruiting participants into the study differ across study groups?		X
	Does the design or analysis control account for important confounding and modifying variables through matching, stratification, multivariable analysis, or other approaches?	X	X
Performance bias	Did researchers rule out any impact from a concurrent intervention or an unintended exposure that might bias results?	X	X
	Did the study maintain fidelity to the intervention protocol?	X	X
Attrition bias	If attrition (overall or differential nonresponse, dropout, loss to follow-up, or exclusion of participants) was a concern, were missing data handled appropriately (e.g., intention-to-treat analysis and imputation)?	X	X

Detection bias	In prospective studies, was the length of follow-up different between the groups?	X	X
	Were the outcome assessors blinded to the intervention or exposure status of participants?	X	X
	Were outcomes assessed/defined using valid and reliable measures, implemented consistently across all study participants?	X	X
	Were confounding variables assessed using valid and reliable measures, implemented consistently across all study participants?		X
Reporting bias	Were the potential outcomes prespecified by the researchers? Are all prespecified outcomes reported?	X	X

Note. RCTs = randomised controlled trials; NRCTs = non-randomised controlled trials.

Table 2 Characteristics and outcomes of the studies included in the review

Study and design	Sample description[a]:	Theoretical framework	Intervention characteristics and control condition	Duration of Intervention and follow-up period	Physical activity measures	Physical activity outcomes	Physical activity mediators outcomes
Boyle et al[26] NRCT	University students enrolled in a health course n=178[b] M=46[b] F=132[b] Mean age=21.1(4.47)[b] Lost to follow-up: not specified	SCT	*Intervention*: participant were assisted by a peer-educator, which boosted outcome expectations and self-efficacy by enabling performance attainments, providing vicarious experience, and delivering verbal persuasion. Peer educators created a tailored exercise program for participants *Control:* participants had to attempt to change behavior without outside help	Intervention: 1 semester Follow-up: N/A	Instrument: self-administered items from the National Health Interview Survey. Measures: energy expenditure (kilocalories/kg/day) and total PA (frequency × duration/week) in the past 2 weeks	Women in the intervention group had a smaller reduction in PA than women in the control group. No significant effects for men. "Inactive" intervention group participants increased their PA and energy expenditure, contrary to controls.	N/A
Bray et al[27] RCT	Freshmen students n=935	SCT	*First-year students brochure intervention:* participants received a brochure providing information	Intervention: N/A	Instrument: MPA and VPA sections of the 2003 Behavior Risk	All groups showed declines in MVPA. Participants in the	No difference between interventions and

	M=100[b] F=155[b] Mean age=17.94(0.66)[b] Lost to follow up: 72.7%		on exercise prescription, strategies to facilitate self-perceptions and motivation to PA *Canada's PA Guide intervention*: participants received a brochure containing information on exercise prescription and health benefits of PA *Control*: no treatment	Follow-up: 6 weeks	Factor Surveillance System interview schedule. Measures: minutes/week of MVPA in the past 8 months (for baseline) and in the past 6 weeks (for follow-up)	First-year brochure intervention showed a smaller decrease in MVPA than the control group. No difference between the Canada's PA Guide condition and the control condition	control groups in action planning and scheduling self-efficacy
Brown et al[28] NRCT	Freshmen students living in university residences n=174 M=73 F=101 Mean age=17.97(0.95) Lost to follow-up: 65.5%	SCT	*Intervention*: practical physical activities, group workshops with a counsellor, seminars focused on PA benefits, recommendations, planning, problem-solving, knowledge sharing, self-monitoring, social support, goal setting, consciousness-rising, time management). Participants received a PA guidebook. *Control*: no treatment	Intervention: 20 weeks Follow-up: N/A	Instrument: Global Physical Activity Questionnaire, Recreational Activity section. Measure: minutes/week of MVPA in the past 30 days.	Participants in the intervention group were more active (MVPA) at post-test than controls	No effects on outcome expectations. Intervention group had higher scores in action planning than control group. Action planning was a predictor of MVPA.

Cavallo et al[29] RCT	Female undergraduate students n=134 Aged <25 years Lost to follow-up: 10.5%	Social support	*Intervention*: participants used a website providing information on PA, and a tool for self-monitoring and goal setting, and were invited to join a Facebook group to exchange social support. A moderator elicited participation and answered to questions *Control*: participants used a limited version of the website, without self-monitoring	Intervention: 12 weeks Follow-up: N/A	Instrument: Paffenbarger Activity Questionnaire (adapted for online use). Measures: Kcal/week of Total PA, VPA, MPA, and LPA	No significant difference in PA changes between intervention and control group	No significant differences in social support changes between intervention and control group
Claxton and Wells[30] RCT	Students enrolled in a health education course n=582 M=206[b] F=159[b] Mean age=19.43(3.41)[b] Lost to follow-up: 37.3%	N/A	*Intervention*: weekly PA homework (used as part of final grades) assigned to participants: keeping a log of the type, length, and intensity of daily PA to be submitted to instructors, and engaging in at least 30 minutes of PA for 3 days *Control*: regular heath classes	Intervention: 12 weeks. Follow-up: N/A	Instrument: Questions from the National Health Interview Survey. Measures: days/week of MPA, VPA, endurance, flexibility and weight management exercise	Intervention group showed an increase in days/week of weight management activity, whereas control group did not. Control group showed an increase in flexibility exercise	N/A

Epton et al[41] RCT	Undergraduate students n=1445 58% females Mean age=18.9 Lost to follow-up: 23.4%	TPB; Self-affirmation theory	*Intervention*: participants were asked to use a website containing a profile page with self-affirmation manipulation, theory-based messages relevant to health behaviors, and a planner to form implementation intentions. An app was provided to access the website from the smartphone *Control*: no treatment	Intervention: 6 months Follow-up: N/A	Instrument: short form of the International Physical Activity Questionnaire. Measure: MET*minutes/week of MVPA in the previous week	No significant difference in PA between intervention and control groups	No significant differences in descriptive and injunctive norm, perceived control, self-efficacy, intention, plan, and attitude toward PA between groups
Franko et al[23] RCT	Full-time undergraduate students n=476 M=204 F=268 Mean age=20.1(1.7) Lost to follow-up: 6.7% at post-test; 11.8% at 3	SCT	Participants used a website containing information on nutrition and PA, interactive activities, goal setting, a self-assessment questionnaire, and questions used to provide feedback to participants. *Intervention 1*: participants used the website for two 45-minute	Intervention 1: 2 weeks Intervention 2: 4 weeks Follow-up: 3 and 6 months	Instrument: International Physical Activity Questionnaire. Measure: MET*minutes/week on MVPA in the previous week	No significant differences in PA between intervention and control groups at any time point	At 3 months, barriers were lower in Intervention 1 than in control. At 6 months, both interventions reported lower barriers than control.

	months; 12% at 6 months.		sessions (2 weeks from one another) *Intervention 2*: participants used the website for two 45-minute sessions and a subsequent booster session (2 weeks from one another) *Control*: no treatment				At 3 months, beliefs on PA benefits were higher in both interventions than in control; the difference remained at 6 months for Intervention 1.
Greene et al[31] RCT	Full-time freshmen, sophomores, or juniors students n=1689 62% females Mean age=19.1(1.1) Lost to follow-up: 62.8%	Dick and Carey's Model of Instructional Design; Keller's Instructional Motivational Model; TMM; SCT	*Intervention*: the intervention consisted in 10 online lessons, focused on attitudes, self-efficacy, weight management and goal setting. Participants had a profile page displaying measurements for each assessment, goals, and self-reported PA compared to recommendations *Control*: no treatment	Intervention: 10 weeks Follow-up: 12 months	Instrument: International Physical Activity Questionnaire. Measure: MET*minutes/week on MVPA in the previous week	Both group decreased their MVPA, but intervention group showed a smaller decrease in MVPA than control group	N/A

Hall and Fong[21] RCT	University students enrolled in a fitness course n=81. M=4 F=77 Mean age=21.2(2.6) Lost to follow-up: 3.7% at post-test; 30.9% at 6 months	Time Perspective Theory	*Time Perspective Intervention*: participants attended three weekly sessions substituted for a part of fitness classes, focused on helping them become more cognizant of long-term benefits of PA, and on long-term goal setting. *Goal-setting control intervention*: the intervention was similar to the Time Perspective group, except for the temporal orientation *Control:* participants attended fitness classes per usual	Intervention: 3 weeks Follow-up: 6 months	Instruments: 30-day recall measure derived from the Stanford 7-Day Recall. Interview-based Physical Activity Recall Measures: Hours of VPA in the past 30 days, minutes of MPA, VPA, very hard PA, strength exercise, and flexibility exercise in the past week	No effect on 30-days VPA. At post-test, time perspective group showed a greater increase in 7-days VPA than control, but not greater than goal-setting group. No effect on other measures and at follow-up. Time perspective group showed a smaller decrease in strength exercises than control, but not smaller than goal-setting group	No intervention effect on long-term thinking about exercise
Hivert et al[24] RCT	Full-time first or second-year students n=115	N/A	*Intervention*: participants attended 23 interactive seminars over 2 years, focused on complications of weight gain, exercise	Intervention: 2 years Follow-up: N/A	Instrument: Canadian Fitness Survey questionnaire.	No statistically significant differences between intervention and control group	N/A

	M=21 F=94 Mean age (intervention group)=19.9(0.2) Mean age(control group)=19.5(0.2) Lost to follow-up: 16.5%		categories, expected benefits and recommendations, problem-solving, goal-setting, self-monitoring, and strategies to maintain a healthy lifestyle. Role models of active lifestyle were offered *Control*: no treatment		Measure: Total PA Kcal/kg/year		
Kattelmann et al[32] RCT	Full-time students n=1639 67% females Mean age=19.3(1.1) Lost to follow-up: 41%	Dick and Carey's model of Instructional Design; TTM	*Intervention*: participants had access to a website containing 21 educational lessons addressing eating behavior, PA, stress management, and healthy weight management. On the website, participants could view their goals, progresses, and behavior recommendations. Participants received e-mail contained stage-tailored videos to reinforce behavior.	Intervention: 15 months Follow-up: N/A	Instrument: International Physical Activity Questionnaire. Measures: MET*minutes/week of total PA, walking, MPA, VPA, in the previous week	No intervention effects on total PA, walking, MPA, and on VPA	No difference between groups in stage of readiness to change

			Control: no treatment				
Kozak et al[25] Factorial RCT	Undergraduate students n=64. 82.8% females Mean age=21 Lost to follow-up: 7.8%	Prospect Theory	The study compared the effect of gain/loss framed messages in normal-weight and overweight students. *Intervention:* participants attended an information session and an exercise instruction session. In the first session, participants received gain or loss framed messages (according to their group) respectively about PA benefits or loss of benefits in sedentary lifestyles.	Intervention: 2-hours session + 2 weeks Follow-up: N/A	Instrument: modified version of the Godin Leisure Time Exercise Questionnaire; recording sheets. Measures: minutes/week of cardiorespiratory MPA and VPA; number of strength training exercises/week	Overweight gain-framed messages group increased cardiorespiratory activity. Normal-weight gain-framed messages, normal-weight loss-framed messages and overweight gain-framed messages groups increased strength exercise	N/A
Le Cheminant et al[33] RCT	Freshmen students n=46 M=17, F=29 Aged 18-24 years	N/A	*Intervention*: participants received a pedometer, and a standard daily steps goal. Participants received an activity record to record their daily step count, and weekly e-mails containing reminders,	Intervention: 27 weeks Follow-up: N/A	Instruments: DIGI-WALKER SW-701 pedometer. FANTASTIC Questionnaire.	No effect of the intervention on PA	N/A

	Lost to follow-up: 26.1%		information on PA benefits, and suggestions to obtain sufficient PA *Control*: participants were advised to maintain their activity patterns		Measures: steps/day; times/week performing MPA and VPA in the past month		
Magoc et al[34] RCT	Full-time or part-time students n=117 Mean age=25.47(6.17)[b] Lost to follow-up: 11%	SCT	*Intervention*: 7 online lessons, focused on self-efficacy, self-regulation, planning, goal setting, barriers, social support, PA benefits, recommendations, suggestions and examples of exercises. Participants received weekly assignments and were asked to submit PA logs *Control:* participants received only basic information on the importance of PA, and were asked to complete PA logs	Intervention: 6 weeks Follow-up: N/A	Instrument: short form of the International Physical Activity Questionnaire. Measures: days/week of MPA, days/week of VPA, minutes/weeks of MPA, minutes/weeks of VPA	Significant increase in days/week of MPA and in days/week of VPA for intervention group, whereas control reported no changes. No changes in minutes/week of MPA and in minutes/week of VPA	No intervention effect on self-efficacy, self-regulation plans, self-regulation goals, expectancies, family social support, and friends' social support

Mailey et al[42] RCT	University students receiving mental health counselling n=47 68.1% females Mean age=25 Lost to follow-up: 7.8%	SCT	*Intervention*: participants had access to a website and attended bimonthly counselling meetings. Topics addressed were PA benefits, exercise safety, self-monitoring, self-efficacy, outcome expectations, goal setting, overcoming barriers to PA, and suggestions for maintaining PA. Participant wore a pedometer and received feedbacks. *Control*: no treatment	Intervention: 10 weeks Follow-up: N/A	Instrument: ActiGraph accelerometer. Measures: 1-minute epochs, 5 days PA, 10 hours/day	Intervention group showed a greater increase in PA compared to the control group, considered statistically significant by the authors, due to the characteristics of the sample (p = .08)	Barriers self-efficacy and exercise self-efficacy declined during the intervention period in intervention and control group
Martens et al[43] RCT	n=67 Intervention: 84.4% females Mean age=19.61(2.41) Control: 80% females	Motivational interview	Intervention: participants attended a one-on-one motivational interviewing session. It included discussion on the decisional balance, personalized PA feedback, addressing barriers to	Intervention: 1 30-minutes session Follow-up: 1 month	Instrument/measures: questions asking number of days/week of 20+ minutes of VPA, and number of days/week of 30+ minutes of MPA in	Participants in the intervention group reported more days/week of 20+ minutes of VPA and more minutes/week of VPA than controls.	N/A

	Mean age=19.61(2.14) Lost to follow-up= 0%		PA, goal setting, and suggestions for increasing PA *Control*: participants were provided with tip sheets including strategies for increasing PA		the last weeks. To the 83% of the participants, it was also asked the number of minutes of MPA and VPA	No statistically significant differences on moderate PA	
Ng et al[35] NRCT	Freshmen students n=331 Intervention: M=50[b] F=43[b] Mean age=19.4(1)[b] Control: M=53[b] F=94[b] Mean age=19.5(1.8)[b] Lost to follow-up: 48%	SCT	*Intervention*: participants attended a physical education course. The contents were fitness equipment usage, skinfold measurements, weight and circuit training, aerobic exercises, endurance run, and relaxation. Participants took part in activities addressing self-efficacy, motives, and barriers *Control*: no treatment	Intervention: 10 weeks Follow-up: N/A	Instrument: Godin Leisure Time Exercise Questionnaire Measures: times/week of engaging in 15+ minutes of LPA, MPA, and VPA, corrected by intensity coefficients	No intervention effects of PA	No intervention effects on exercise self-efficacy, motives, and barriers

Okazaki et al[36] RCT	n=84 Intervention: M=35[b] F=14[b] Mean age=19.1(1.3)[b] Control: M=15[b] F=13[b] Mean age=19.4(1.2) [b] Lost to follow-up: 8.3%	SCT; Health belief model	*Intervention*: participants had access to a website containing goal-setting, scheduling, self-monitoring, information on PA (health behavior skills, body images, training), quizzes, and energy expenditure calculations. Participants received advice according to PA reported *Control*: no treatment	Intervention: 1 year Follow-up: N/A	Instrument: short form of the International Physical Activity Questionnaire. Measure: Kcal/day	Only participants of the intervention group that at baseline did not engage in regular university sports showed greater level of PA than controls after the intervention	All participants of the intervention group progressed through stages of change whereas control group had no improvement
Parrott et al[44] RCT	Sedentary university students n=170 M=105 F=65 Mean age=20.2(0.9) Lost to follow-up: 0%	TPB	*Positive framed messages intervention:* participants received e-mails containing positive-framed messages about PA every other day for two weeks *Negative framed messages intervention*: participants received e-mails containing negative-	Intervention: 2 weeks Follow-up: 1 week	Instrument: modified version of the Godin Leisure Time Exercise Questionnaire. Measure: times/week engaging in 30+ minutes of MPA or VPA	Positive-framed messages group had higher PA scores than control group at post-test and at follow-up, and higher PA scores than negative-framed messages group at post-test and at follow-	At follow-up, the positive-framed messages group scored higher than the control group on intention, affective attitude, instrumental attitude,

			framed messages about PA every other day for two weeks *Control*: no treatment			up as regards participants with low baseline PA.	subjective norm and perceived behavioral control
Priebe and Spink[22] RCT	University students n=310 M=45[b] F=166[b] Mean age=21.6(4.2)[b] Lost to follow-up: 31.9%	Theory of normative conduct	Participants received four e-mails, with motivational information. Reasons for being active were specific to the experimental group *Descriptive norm intervention*: descriptive norms *Health promoted intervention*: health *Appearance promoted intervention*: appearance *Control*: messages simply promoted being active	Intervention: 15 days Follow-up: N/A	Instrument: Godin Leisure Time Exercise Questionnaire. Measure: times/week of engaging in 15+ minutes of LPA, MPA and VPA, corrected by intensity coefficients	No significant differences in PA levels change between the descriptive norm intervention group and the other conditions	N/A
Quintiliani et al[37] RCT	Female university students n=408	Elaboration Likelihood Model; TTM	Participants visualized online messages about one among six health-related topics, including a feedback comparing participants' behavior to recommendations, a	Intervention: one session Follow-up: 1 month	Instrument: questions from the U.S. Behavioral Risk Factor Surveillance Survey.	At follow-up change in VPA was significantly greater in the expert group than in the control group. No	At post-test, change in self-efficacy and goal commitment was greater in the

	Aged 18-21=210, aged 22-29=146, aged ≥30=52 Lost to follow-up: 48.5%		testimonial of behavior change, answers tailored to participants' reported barriers, and a stage-tailored action plan. *Choice group:* participants autonomously selected the topic *Expert group*: the topic was chosen by an expert on the basis of a baseline survey indicating whether the participant met PA recommendations *Control*: participants received messages on reducing stress		Measures: minutes/week of MPA and VPA	intervention effect for the choice group[c]	expert group than in the control group. At follow-up there were no differences in intention, self-efficacy, goal commitment and goal difficulty
Rote et al[38] RCT	Female freshmen students n=63 Mean age=18.6(0.7) Lost to follow-up: 15.9 %	Social support	Participants received a pedometer, PA logs, and weekly-personalized steps goals *Intervention*: on a Facebook group, participants reported their steps/day, the ways in which they reached their goals, and provided	Intervention: 8 weeks Follow-up: N/A	Instrument: pedometer Yamax SW-200. Measure: steps/day	Participants in the Facebook social support group reported a greater change in steps/day than participants in the control group only	N/A

			feedback and encouragement to other participants. Posts with information about PA were added weekly *Control*: participants received e-mails including personalized goals, feedbacks, and information about PA				between the 7th and the 8th week
Sallis et al[45] RCT	Seniors students n=338 M=153 F=185 Lost to follow-up: 5%	SCT; TTM	*Intervention*: participants attended to lectures and laboratories. Lectures focused on PA benefits, recommendations, injuries, and self-management. Some topics were stage-tailored. Participants were required to write a PA plan. Two type of laboratories (adoption and maintenance of PA) were available, and taught aerobic, resistance, and flexibility exercise, and self-management	Intervention. 15 weeks Follow-up: N/A	Instrument: physical activity recall interview. Measures: Kcal/kg*week spent in the past 7 days in MPA, VPA, and very hard leisure PA; hours/week of MPA and VPA; minutes/weeks spent	No effect for males. Intervention effects were found for females as regards minutes of strengthening and flexibility exercise, and for "active" females as regards Kcal/kg*week.	At post-test, intervention women were less likely to be in the contemplation stage and more likely to be in the action and maintenance stages than control women

			Control: general health course		in strengthening and flexibility exercise		
Skår et al[46] RCT	University students n=1273 63.4% females Mean age=22.8(6.7) Lost at follow-up: 46.8%	TPB	*Action planning intervention*: participants received information on action planning and where asked to create 3 plans for PA. *Coping plan intervention*: participants received information on coping plans, and were asked to create 3 plans for coping with PA barriers *Planning & coping intervention*: participants received both the treatments previously described *Control*: no treatment	Intervention: 1 session (mean duration ranging from 9 to 12 minutes) Follow-up: 8 weeks	Measure: number of sessions/week of at least 30 minutes of PA in the past week	No intervention effect on PA	No intervention effect on intention and perceived behavioral control
Sriramatr et al[39] RCT Solomon 4-group	Female students n=220 Mean age=19 Lost to follow-up: 10.9 at post-test;	SCT	*Intervention*: participants received a pedometer and recorder their PA on a website, where they could set weekly goals and identify their PA related self-efficacy and	Intervention: 3 months Follow-up: 3 months.	Instrument: Godin Leisure Time Exercise Questionnaire;	At post-test and at the follow-up, participants in intervention group reported more steps/day and more	At post-test and at the follow-up participants in intervention group reported higher

	20.5% at the follow-up		outcome expectations. Weekly e-mails advised participants to increase their MVPA of at least 9 minutes per week and provided feedbacks. Participants received information about benefits of PA, workouts methods, PA guidelines, and PA role models *Control*: no treatment.		Yamax Digi-Walker SW-701 pedometer Measures: times/week of engaging in 15+ minutes of LPA, MPA and VPA, corrected by intensity coefficients; steps taken over 3 days	self-reported PA than those in the control group	self-efficacy, outcome expectations, and self-regulation than those in the control groups
Wadsworth and Hallam[40] RCT	Female college students n=91 Lost to follow-up: 22%.	SCT	*Intervention*: Participants had access to a website and received weekly e-mails. Topics addressed were self-regulation (goal setting, time management, self-monitoring, reinforcements, relapse prevention), self-efficacy, outcome expectancy, overcoming barriers, and social support. An online counsellor suggested	Intervention: 6 months Follow-up : N/A	Instrument: short form of the International Physical Activity Questionnaire. Measures: MET*minutes/week of MVPA in the previous week	No significant differences between intervention and control group in PA levels	No differences between intervention and control group in self-regulation, exercise self-efficacy, and outcome expectancy

			exercise regimens and replied to questions. The web site also contained discussion boards, and exercise information *Control*: no treatment				
Werch et al[19,20] RCT	n=299 59.5% females Mean age=19.2(1.12) Lost to follow-up: 5% at 3 months; 23% at 12 months	Behavior-Image Model	*Intervention*: one-on-one consultations, providing tailored gain-framed and loss-framed content addressing health behaviors, and their relation to salient image achievement. A fitness specialist provided participants with a goal plan, consisting in goals reflecting one's image/aspirations, and fitness recommendations *Control*: participants received a brochure including information on PA benefits, characteristics of fit people, an action plan, and a	Intervention: one 25-minute consultation Follow-up:3 months, 12 months	Instrument: updated Fitness & Health Survey. Measures: at 3 months, length of exercising, 30-day VPA, 30-day MPA, 7-day VPA, and 7-day MPA were measured. At 12 months, only 30-day MPA was measured	At 3 months, Intervention group participants showed an increase in 30-day MPA, whereas control group decreased. From 3 to 12 months, both intervention and control groups showed a decrease in 30-days MPA, but the decrease for the intervention group was significantly smaller than that for the control group	N/A

								commitment form to identify healthy/unhealthy habits		

Note. PA = physical activity; LPA = light intensity physical activity; MPA = moderate intensity physical activity; VPA = vigorous intensity physical activity; MVPA = moderate-to-vigorous intensity physical activity; RCT = randomised controlled trial = NRCT, non-randomised controlled trial; N/A = not applicable; SCT = Social-cognitive theory; TTM = Transtheoretical model of behaviour change; TPB = Theory of planned behaviour; n = number of participants; M = number of male participants; F = number of females participants; MET = metabolic equivalent of task.

[a] Target population, sample size, number of males and females participants (or % of females), mean age (SD) (or age range), percentage of participants lost to follow-up Percentage of females and age range are reported in place of, respectively, the number of males and females participants and the mean age of participants, when these data are missing in the paper.

[b] Data referring only to participants analysed in the study, because data for all the randomized participants were not reported.

[c] Physical activity outcomes are reported for 244 participants only, those who received messages on physical activity.

Table 3 Statistical significance of the differences, and standardized mean differences of changes between intervention and control groups.

Study	Statistical test used	PA measures[a]	Sub-set on analysis (when applicable)	*P* value	Standardized mean difference of changes
Boyle et al.[26]	Group x time ANCOVA; season of assessment used as covariate	Total PA	Female participants	N.S.	.28
			Male participants	N.S.	.41
			Participants that were inactive at baseline	< .05	.46
			For participants that were active at baseline	N.S.	- .13
Bray et al.[27]	ANCOVA; baseline MVPA used as covariate; pairwise simple contrasts used as post-hoc test	MVPA	Overall ANCOVA	.05	N/A
			First year student brochure group against Canada's PA Guide intervention group	N.S.	N/A
			First year student brochure group against control group	.03	.08
			Canada's PA Guide intervention group against control group	N.S.	.16

Brown et al.[28]	1-way ANCOVA; baseline MVPA used as covariate	MVPA	N/A	< .001	.93
Cavallo et al.[29]	Linear mixed model; group x time interaction	Total PA	N/A	N.S.	.18
		VPA	N/A	N.S.	- .22
		MPA	N/A	N.S.	.23
		LPA	N/A	N.S.	- .23
Claxton and Wells[30]	T-test on change scores	MPA	N/A	N.S:	.19
		VPA	N/A	N.S.	.08
		Endurance activities	N/A	N.S.	.14
		Flexibility exercise	N/A	N.S.	.02
		Wight management activities	N/A	.03	.23

Epton et al.[41]	ANCOVA and logistic regression analyses (controlling for corresponding baseline scores, sex, age and nationality)	MVPA	N/A	N.S.	.07
Franko et al.[23]	Mixed models for repeated measures	MVPA	Intervention 1 against control (post-test)	N.S.	.06
			Intervention 1 against control (3-month follow-up)	N.S.	.002
			Intervention 1 against control group (6-month follow-up)	N.S.	.18
			Intervention 2 against control group (post-test)	N.S.	- .05
			Intervention 2 (3-month follow-up)	N.S.	- .06
			Intervention 2 against control group (6-month follow-up)	N.S.	.21
Greene et al.[31]	Group x time MANCOVA; sex used as a covariate	MVPA	Overall MANCOVA	< .05	
			Baseline to post-test	N/A	3.41
			Baseline to follow-up	N/A	2.73

Hall and Fong[21]	Group x time interaction. Planned comparisons used as post-hoc	30-day VPA	Time perspective group against Goal-setting group (post-test)	N.S	.29[b]
			Time perspective group against Goal-setting group (follow-up)	N.S.	.92[b]
			Time perspective group against control group (post-test)	N.S	.35[b]
			Time perspective group against control group (follow-up)	N.S.	.36[b]
			Goal setting group against control group (post-test)	N.S	0[b]
			Goal setting group against control group (follow-up)	N.S.	- .58[b]
		7-day VPA	Time perspective group against Goal-setting group (post-test)	N.S	.26[b]
			Time perspective group against Goal-setting group (follow-up)	N.S	- .15[b]
			Time perspective group against control group (post-test)	p=0.002	.97[b]
			Time perspective group against control group (follow-up)	N.S	.28[b]

			Goal setting group against control group (post-test)	N.S.	.77[b]
			Goal setting group against control group (follow-up)	N.S	.41[b]
Hivert et al.[24]	Group x time repeated measures ANOVA	Total PA	N/A	N.S.	.21
Kattelmann et al.[32]	Mixed model repeated measures (group x time)	Total PA	N/A	N.S.	- .03
		Walking	N/A	.05	- .17
		MPA	N/A	N.S.	.05
		VPA	N/A	N.S.	- .03
Kozak et al.[25]	Wilcoxon rank-sum tests on change values (baseline to post-test)	MVPA	N/A	N.S.	Standardized mean differences are not available for the rank-sum outcome reported
Le Cheminant et al.[33]	Group x time mixed model	MVPA	N/A	N.S.	PA data were not reported
Magoc et al.[34]	MANOVA (using minutes/week and days/week of MPA and	N/A	Overall MANOVA	< .001	Means and standard deviations are reported for the whole sample, but not for the two
		Days/week of MPA	N/A	.001	

	VPA), and univariate group x time interactions	Days/week of MPA	N/A	< .001	groups (intervention and control) separately
		Minutes/week of MPA	N/A	N.S.	
		Minutes/week of VPA	N/A	N.S.	
Mailey et al.[42]	Group x time ANOVA	Total PA	N/A	.08[c]	.78
Martens et al.[43]	ANCOVA	VPA	N/A	.02	No post-test data reported
		MPA	N/A	N.S.	
Ng et al.[35]	Repeated measures ANOVA	Total PA	Males Participants	N.S.	- .33
			Females Participants	N.S.	.07
Okazaki et al.[36]	Group x time ANOVA	MVPA	Whole sample	: N.S.	No post-test data reported
			Participants that at baseline did not engage in regular university sport	< .05	
			Participants that at baseline engaged in regular university sport	N.S.	
Parrott et al.[44]		MVPA	Positive framed messages group against control group (post-test)	Statistically significant[d]	Post-test and follow-up means not reported in the article

	ANCOVA; pairwise comparisons used as post hoc test		Positive framed messages group against control group (follow-up)	Statistically significant[d]	
			Negative framed messages group against control group(post-test)	N.S.	
			Negative framed messages group VS Control (follow-up)	N.S.	
			Positive framed messages group against Negative framed messages group (post-test)	Statistically significant[d] for the participants who had low baseline PA scores	
			Positive framed messages group VS Negative framed messages group (follow-up)	Statistically significant[d] for the participants who had low baseline PA scores	
Priebe and Spink[22]	Planned contrast using change scores	Total PA	N/A	N.S.	No data reported
Quintiliani et al.[37]	Linear regression modelling	MPA	Expert group against control group	N.S.	The standard deviations reported for baseline measures refers to a different number of participants
			Choice group against control group	N.S.	
			Expert group against Choice group	N.S.	
		VPA	Expert group against control group	< .01	

			Choice group against Control group	N.S.	in comparison to those analyzed
			Expert group against Choice group	N.S.	at the follow-up
Rote et al.[38]	Repeated measures ANOVA (2 groups x 9 time points). Test of simple main effects used as post-hoc test	Steps/day	Overall ANOVA	< .0004	Means and standard deviations reported in the table refer to groups of different size
			Simple main effects (from the 7th to the 8th week)	< .001	
Sallis et al.[45]	ANCOVA	Total leisure time PA	Males Participants	N.S.	Post-test data not reported
			Female Participants	.03	
		VPA	Males Participants	N.S.	
			Female Participants	N.S.	
		MPA	Males Participants	N.S.	
			Female Participants	N.S.	
			Males Participants	N.S:	

		Resistance exercise	Female Participants	.001	
		Flexibility exercise	Males Participants	N.S.	
			Female Participants	.001	
Skar et al.[46]	ANCOVA	Total PA	N/A	N.S.	No baseline means and standard deviations reported for the four groups separately
Srirmatr et al.[39]	ANOVA	Steps/day	Post-test	< .01	1.40[e]
			Follow-up	< .01	.73[e]
		Leisure PA	Post-test	< .01	1.25[e]
			Follow-up	< .01	.72[e]
Wadsworth and Hallam[40]	ANCOVA	MVPA	N/A	N.S.	Means and standard deviations reported in the article refer to groups of different size
Werch et al.[19]	Repeated measures MANOVAs	Length of exercise	N/A	N.S.	.067
		30-day VPA	N/A	N.S.	.017
		30-day MPA	N/A	.03	.25

		7-day VPA	N/A	N.S.	.039
		7-day MPA	N/A	N.S.	0
Werch et al.[20]	MANOVA	30-day MPA	N/A	.04	.29

Note. N.S. = not statistically significant, $P > .05$; PA = physical activity; LPA = light intensity physical activity; MPA = moderate intensity physical activity; VPA = vigorous intensity physical activity; MVPA = moderate-to-vigorous intensity physical activity; ANOVA = analysis of variance; ANCOVA = analysis of covariance; MANOVA = multivariate analysis of variance; MANCOVA = multivariate analysis of covariance.

[a] Physical activity measures are reported to distinguish the results in those studies that used more than one measure of physical activity. For further specifications on the measures, like units of measurement, see Table 2.

[b] Sample size varied from baseline to post-test and follow-up, due to missing data.

[c] Authors considered the difference between groups statistically significant due to the characteristics of the sample.

[d] Authors stated that the difference was statistically significant, but no data were reported.

[e] Standardized mean difference based only on the scores of the groups with pre-test, in a Solomon 4-group design study.

Table 4 Rating of the risk of bias of the included studies

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Boyle et al.[26]	High risk: discretionary allocation	Low risk	Unclear risk: dropout rate not specified	Low risk	Low risk	High risk
Bray et al.[27]	Unclear risk: random sequence generation method not clearly described	Low risk	High risk: 72.7% of the participants lost to follow up; loss not handled with ITT	High risk: baseline PA refers to the 8 months before the measurement, whereas follow-up PA refers to the 6 weeks before the measurement	Low risk	High risk
Brown et al.[28]	High risk: discretionary allocation. Potential confounders not controlled	Unclear risk Authors state lack of control on intervention delivery fidelity	High risk: 65.5% of participants lost to follow-up; loss not handled with ITT. Participant's reasons for dropout not specified	Low risk	Low risk	High risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Cavallo et al.[29]	Unclear risk: randomization procedure not described	Low risk	High risk: significant difference in attrition between groups	Low risk	Low risk	High risk
Claxton and Wells[30]	High risk: block randomization procedure not described. At baseline, control group had higher mean PA level than Intervention group	Low risk	Unclear risk: 37.3% of participants lost to follow-up; loss not handled with ITT	Unclear risk: imprecise PA measure used	High risk: selective reporting (authors states that PA was measured as days of PA*duration/week, but only days/week of PA measures are reported)	High risk
Epton et al.[41]	Low risk	Low risk	Unclear risk: 23.4% of participants lost to follow-up; last observation carried forward used to impute missing data	Low risk	Low risk	Unclear risk
Franko et al.[23]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Greene et al.[31]	Unclear risk: randomization procedure not described	Low risk	High risk: 62.8% of participants lost to follow-up; loss not handled with ITT	Low risk	Low risk	High risk
Hall and Fong[21]	Unclear risk: random sequence generation method not described	Low risk	High risk: 30.9% of participants lost to follow-up at 6 months; loss not handled with ITT	Unclear risk: the number of the participants assessed differs between different measures of PA. Outcome assessors blinding not described for interview-based measures	High risk: selective reporting (only measures of VPA from the 30-day recall measure were reported; the rationale provided by the authors to justify this choice contrasts with the choice of reporting other measures of PA in the results)	High risk
Hivert et al.[24]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Kattelmann et al.[32]	Low risk	Low risk	High risk: 41 % of participants lost to follow-up; lost not handled with ITT. Participant's reasons for dropout not specified	Low risk	Low risk	High risk
Kozak et al.[25]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
LeCheminant et al.[33]	Unclear risk: random sequence generation not described	High risk: control participants were advised to maintain their PA habits. Intervention group participants were paid to participate in the study more than control group participants were	Low risk	Unclear risk: imprecise PA measure used	Unclear risk: PA data partially reported	High risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Magoc et al.[34]	Unclear risk: randomization procedure not described	Low risk	Low risk	High risk: PA questionnaire data were not properly used. Authors do not specify what criteria was used to define a day of MPA or VPA as valid	High risk: selective reporting (measures of min/week of PA not reported; data presented for the whole sample, but not for the two groups separately)	High risk
Mailey et al.[42]	Unclear risk: no randomization described	Low risk	Low risk	Low risk	Low risk	Unclear risk
Martens et al.[43]	Unclear risk: at baseline, groups differed in days/week of MPA and VPA than control, but not in minutes/week of MPA and VPA	Low risk	Low risk	Unclear risk: minutes/week of PA were not measured on the whole sample. Imprecise PA measure used	Unclear risk: post-test PA data not reported	Unclear risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Ng et al.[35]	High risk: intervention group participants were enrolled in a physical education course, unlike control participants	Low risk	High risk: 48 % of participants lost to follow-up; lost not handled with ITT. Participant's reasons for dropout not specified	Unclear risk: imprecise PA measure used	Low risk	High risk
Okazaki et al.[36]	High risk: no explanation of randomization, criteria to allow registration in the courses, and requirements for students randomized as controls to be admitted. Authors state that intervention group participants might have preferred to be more active than control group participants	Low risk	Low risk	Low risk	High risk: authors stated that data were analyzed using a RMANOVA, but they reported only the results of analysis conducted analyzing participants that engaged in university sports separately from those that did not engaged in university sports	High risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Parrott et al.[44]	Unclear risk: authors state that researchers were aware of group allocation	Low risk	Low risk	Unclear risk: PA questionnaire not properly scored. Imprecise PA measure used	Unclear risk: post-test and follow-up PA data, and statistical analysis results not reported	Unclear risk
Priebe and Spink[22]	Unclear risk: randomization procedure not described	Low risk	High risk: 31.9% of participants lost to follow-up; loss not handled with ITT	Unclear risk: imprecise PA measure used	Unclear risk: no PA data reported	High risk
Quintiliani et al.[37]	Low risk	Low risk	Unclear risk: 48.5% of participants lost to follow-up; last observation carried forward used to impute missing data	High risk: authors state that the number of participant vary across different PA variables due to missing data	Low risk	High risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Rote et al.[38]	Low risk	Low risk	Low risk	High risk: PA data at different time points refer to different participants, due to missing data	Low risk	High risk
Sallis et al.[45]	Unclear risk: randomization procedure not described	Low risk	Low risk	Unclear risk: outcome assessors blinding not described for interview-based measures	Unclear risk: post-test PA data not reported	Unclear risk
Skår et al.[46]	Low risk	Low risk	Low risk	Unclear risk: discrepancy between the PA questionnaire described and the unit of measurement of PA outcomes. Imprecise PA measures used	Low risk	Unclear risk

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall risk of bias
Sriramatr et al.[39]	Low risk	High risk: intervention group participants were paid three times more to participate in the study than control group participants	Low risk	Unclear risk: imprecise PA measures used	Low risk	High risk
Wadsworth & Hallam[40]	Unclear risk: randomization procedure not described	Low risk	High risk: 22% of participants lost to follow-up; loss not handled with ITT	Low risk	Low risk	High risk
Werch et al.[19,20]	Unclear risk: no randomization described	Low risk	Low risk	Low risk	Low risk	Unclear risk

Note. PA = physical activity; MPA = moderate intensity physical activity; VPA = vigorous intensity physical activity; ITT = intention-to-treat analysis; ANOVA = analysis of variance; RMANOVA = repeated measures analysis of variance.