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Short Report: Care Delivery

Successful behavioural strategies to increase physical activity and improve glucose control in adults with Type 2 diabetes

L. Avery[1]*, D. Flynn[2]*, S. U. Dombrowski[3], A. van Wersch[4], F. F. Sniehotta[2] and M. I. Trenell[1]

[1]Institute of Cellular Medicine, [2]Institute of Health and Society, Newcastle University, Newcastle Upon Tyne, [3]School of Natural Sciences, Division of Psychology, University of Stirling, Stirling, and [4]School of Social Sciences and Law, Teesside University, Middlesbrough, UK

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Abstract

Aims To explore which behaviour change techniques and other intervention features are associated with increased levels of physical activity and improved HbA_{1c} in adults with Type 2 diabetes.

Methods Moderator analyses were performed on a dataset of 21 behaviour change techniques and six intervention features identified in a systematic review of behavioural interventions (N = 1975 patients with Type 2 diabetes) to establish their associations with changes in physical activity and HbA_{1c}.

Results Four behaviour change techniques (prompt focus on past success, barrier identification/problem-solving, use of follow-up prompts and provide information on where and when to perform physical activity) had statistically significant associations with increased levels of physical activity. Prompt review of behavioural goals and provide information on where and when to perform physical activity behaviour had statistically significant associations with improved HbA_{1c}. Pedometer use was associated with decreased levels of physical activity.

Conclusions These data suggest that clinical care teams can optimise their consultations by incorporating specific behaviour change techniques that are associated with increased levels of physical activity and improved long-term glycaemic control.

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Introduction

There is substantial evidence to demonstrate that physical activity/exercise (hereafter referred to as physical activity) is of benefit to people with Type 2 diabetes [1–3]. However, the greatest clinical challenge is understanding how to support people to change their physical activity behaviour in the context of their everyday lives. Our 2012 systematic review and meta-analysis [4] reported that behavioural interventions targeting free-living physical activity behaviour in adults with Type 2 diabetes (age range 35 to 75 years, with the majority of studies having recruited adults aged 60 to 64 years) yielded long-term clinically significant improvements in HbA_{1c}. However, identification of which components of these interventions produce the greatest improvements in physical activity behaviour and subsequently HbA_{1c} has not been formally tested. With clinical consultations and resources limited, insights into the efficacy of behaviour change techniques may assist in optimising the consultation.

Our objective was to explore which behaviour change techniques [5] and other intervention features (mode of delivery, intensity, duration, use of model/theory of behaviour change, use of pedometers and supervised physical activity and exercise sessions) used in behavioural interventions were associated with change in physical activity behaviour and clinically significant improvements in HbA_{1c} (i.e. a decrease in $HbA_{1c} \leq 0.3\%$) to help inform clinical practice and the development of new interventions.

Methods

In accordance with previously published research [6], effect size measures for physical activity and HbA_{1c} were mean difference and Hedges' g. Subgroup analyses were conducted

Correspondence to: Leah Avery. E-mail: leah.avery@newcastle.ac.uk
*Joint first authors.

What's new?

- This study reports on statistically significant associations between evidence-based behaviour change techniques, changes in physical activity behaviour and clinically significant improvements in glycaemic control in adults with Type 2 diabetes.
- The findings provide guidance for clinicians on five context-appropriate behaviour change strategies for use during time-constrained consultations, which can help to support people with Type 2 diabetes to increase their levels of physical activity in order to maximise long-term glycaemic control.
- The five behaviour change techniques identified were: prompt focus on past success, barrier identification/problem-solving, use of follow-up prompts, provide information on where and when to perform the behaviour and prompt review of behavioural goals.

for behaviour change techniques and other categorical intervention features using a mixed-effect model where: (1) subgroups are pooled using a random-effects model; and (2) tests for statistically significant differences between subgroups are conducted with a fixed-effects model. All moderator analyses were undertaken using comprehensive meta-analysis. Associations between effect sizes and continuous variables were examined with meta-regression using the 'metareg' command in STATA applying a restricted maximum likelihood (REML) approach to estimate between-study variance.

The association between changes in physical activity and HbA_{1c} across all 21 behaviour change techniques was calculated with Spearmans correlation.

Results

Four behaviour change techniques were associated with increased levels of physical activity when present (Table 1). These were in rank order of effect size (Q): (1) prompt focus on past success; (2) barrier identification/problem-solving; (3) use of follow-up prompts; and (4) provide information on where and when to perform physical activity behaviour. Two behaviour change techniques were associated with improvements in HbA_{1c} when present (Table 2). These were in rank order of effect size: (1) prompt review of behavioural goals, and (2) provide information on where and when to perform physical activity behaviour.

Pedometer use was associated with decreased levels of physical activity (Table 1). There were no other statistically significant associations between intervention features and effect size changes.

A negative statistically significant relationship was found between effect size changes in physical activity and HbA_{1c} across the 21 behaviour change techniques included in the analysis using 21 comparisons for which full data was available ($r_s = -0.62$, $P = 0.004$).

Conclusions

The field of behavioural science is beginning to establish the principles of how to effectively support patients to make positive behavioural changes. The analyses presented are the first to link behavioural outcomes with clinically meaningful outcomes and to identify behaviour change techniques that may help to optimise diabetes care consultations: (1) prompt focus on past success (identifying and emphasising successful behaviour change from the individual's past); (2) barrier identification/problem-solving (identifying salient barriers to physical activity for the individual and strategies to overcome them); (3) use of follow-up prompts (such as reminder postcards or motivational telephone calls); (4) provide information on where and when to perform the behaviour (individuals are given explicit information on locations, times and opportunities available locally for changing physical activity behaviour); and (5) prompt review of behavioural goals (review whether physical activity goals were achieved followed by revisions or adjustments).

By examining behavioural and clinical outcomes, these data suggest that clinical care teams could optimise the limited time they have with patients by focusing on selected behaviour change techniques to change physical activity behaviour.

There are interesting contrasts in the literature reporting on behaviour change techniques to target other lifestyle behaviours. In a 2011 systematic review, provision of instruction, self-monitoring of behaviour and relapse prevention were most strongly associated with weight loss when targeting diet in obese adults with additional risk factors for co-morbidity [3]. A 2014 systematic review reporting on behavioural interventions targeting physical activity behaviour in older adults showed associations between self-monitoring and a decrease in physical activity behaviour. The authors suggested that specific self-regulatory techniques may carry greater cognitive burden, making utilisation and thus behaviour change difficult [7]. Practically, this highlights that different behaviour change techniques may be required to initiate changes in different target behaviours (e.g. physical activity and diet), outcomes of behaviour (e.g. HbA_{1c} and weight) and demographics of individuals (e.g. age), and that a tailored approach is necessary. Combined, these data suggest that a 'one size' behavioural intervention may not fit all and that clinical care teams should have an array of behaviour change techniques at their disposal and be aware of the context in which they may be most effective.

The specificity of behaviour change techniques is highlighted by the use of pedometers. Meta-analyses [8] show that pedometer use, a way to actualise self-monitoring of behaviour, is effective for increasing physical activity behaviour. However, more specific analyses reveal that the benefits of pedometer use may not carry across all users and that some

Table 1 Behaviour change technique moderator analyses for physical activity

			Meta-analysis (random effects model)						Subgroup analysis	
			Standardised mean difference: intervention	95% CI		Standardised mean difference: control	95% CI			
Intervention feature	*k* present (absent)	*n* present (absent)	Present	Lower limit	Upper limit	Absent	Lower limit	Upper limit	*Q*	*P*
Behaviour change techniques										
Prompt focus on past success	4 (17)	415 (1352)	1.47	0.91	2.03	0.48	0.28	0.69	10.72	0.001
Barrier identification/ problem-solving	15 (6)	1016 (751)	0.81	0.50	1.13	0.31	0.16	0.45	8.16	0.004
Use of follow-up prompts	14 (7)	989 (778)	0.78	0.44	1.12	0.36	0.33	0.50	5.07	0.024
Provide information on where and when to perform the behaviour	8 (13)	680 (1087)	0.95	0.52	1.38	0.45	0.24	0.66	4.21	0.040
Plan social support/social change	13 (8)	894 (873)	0.81	0.45	1.17	0.45	0.22	0.67	2.84	0.092
Provide information on consequences of behaviour to the individual	5 (16)	476 (1291)	1.17	0.38	1.96	0.53	0.32	0.73	2.37	0.124
Prompt review of behavioural goals	14 (7)	920 (847)	0.77	0.43	1.12	0.47	0.22	0.72	1.97	0.160
Relapse prevention/coping planning	11 (10)	543 (1224)	0.51	0.19	0.83	0.81	0.45	1.18	1.48	0.223
Goal setting (behaviour)	16 (5)	984 (783)	0.73	0.41	1.04	0.49	0.17	0.80	1.11	0.291
Provide information on consequences of behaviour in general	10 (11)	417 (1350)	0.80	0.34	1.25	0.58	0.29	0.88	0.59	0.444
Provide instruction on how to perform the behaviour	13 (8)	990 (777)	0.72	0.44	1.01	0.53	0.10	0.96	0.54	0.464
Motivational interviewing	3 (18)	156 (1611)	0.49	0.05	0.93	0.68	0.41	0.94	0.52	0.470
Goal setting (outcome)	3 (18)	123 (1644)	0.88	0.16	1.60	0.62	0.36	0.88	0.44	0.510
Prompt rewards contingent on effort or progress towards behaviour	3 (18)	123 (1644)	0.88	0.16	1.60	0.62	0.36	0.88	0.44	0.509
Prompt generalisation of a target behaviour	3 (18)	123 (1644)	0.88	0.16	1.60	0.62	0.36	0.88	0.44	0.509
Set graded tasks	10 (11)	1252 (515)	0.72	0.35	1.10	0.60	0.30	0.90	0.26	0.612
Teach to use prompts/cues	4 (17)	231 (1536)	0.69	0.28	1.09	0.64	0.36	0.93	0.03	0.862
Action planning	6 (15)	339 (1428)	0.66	0.32	0.99	0.66	0.35	0.97	0.00	0.991
Prompt self-monitoring of behaviour	16 (5)	656 (1111)	0.66	0.37	0.94	0.64	0.16	1.12	0.00	0.958
Provide feedback on performance	7 (14)	336 (1431)	0.65	0.22	1.09	0.66	0.36	0.95	0.00	0.984
Modes of delivery										
Pedometer use	8 (13)	377 (1390)	0.36	0.08	0.64	0.83	0.51	1.16	4.60	0.032
Theory based	18 (3)	1638 (129)	0.71	0.44	0.98	0.34	−0.01	0.69	2.74	0.098
Individual and group contact	3 (18)	78 (1689)	1.42	0.07	2.76	0.58	0.34	0.81	1.44	0.230
Group contact	5 (16)	203 (1564)	0.58	0.29	0.87	0.68	0.39	0.97	0.20	0.655
Individual contact	12 (9)	1428 (339)	0.64	0.34	0.94	0.70	0.26	1.14	0.05	0.820
Supervised	8 (13)	817 (950)	0.67	0.29	1.05	0.64	0.32	0.95	0.02	0.892

groups benefit less, particularly older people [7]. The present analyses suggest that people with Type 2 diabetes, the majority of which were older adults (aged > 60 years), may be a group who benefit less from pedometer use. It is not that pedometers do not yield effective behaviour change, but that specific groups may require greater support to use them as an effective self-monitoring tool. Furthermore, age of participants included in the current analyses may account for other behaviour change techniques failing to reach statistical significance such as plan social support/social change. In their 2014 systematic review, French and colleagues reported that social support was associated with lower levels of physical activity behaviour in older adults aged > 60 years [7].

Overall, these data highlight the pressing need to understand more about the specific requirements of people with Type 2 diabetes, and also the transferability of behaviour change techniques and other intervention features across groups and clinical conditions.

Targeting physical activity behaviour is an important self-management option for people with Type 2 diabetes and

Table 2 Behaviour change technique moderator analyses for HbA_{1c}

Intervention feature	*k* present (absent)	*n* present (absent)	Meta-analysis (random effects model)						Subgroup analysis	
			Mean difference intervention	95% CI		Mean difference control	95% CI			
			Present	Lower limit	Upper limit	Absent	Lower limit	Upper limit	*Q*	*P*
Behaviour change techniques										
Prompt review of behavioural goals	14 (7)	920 (847)	−0.53	−0.71	−0.34	−0.23	−0.41	−0.06	5.09	0.024
Provide information on where and when to perform the behaviour	8 (13)	680 (1087)	−0.54	−0.74	−0.34	−0.26	−0.45	−0.07	3.86	0.050
Prompt generalisation of a target behaviour	3 (18)	123 (1644)	−0.73	−1.16	−0.31	−0.31	−0.47	−0.16	3.29	0.070
Plan social support/social change	13 (8)	894 (873)	−0.50	−0.69	−0.32	−0.24	−0.49	0.00	2.78	0.095
Prompt self-monitoring of behaviour	16 (5)	656 (1111)	−0.23	−0.44	−0.02	−0.47	−0.68	−0.25	2.41	0.120
Goal setting (behaviour)	16 (5)	984 (783)	−0.45	−0.63	−0.27	−0.23	−0.48	0.03	2.02	0.156
Prompt focus on past success	4 (17)	415 (1352)	−0.54	−0.80	−0.29	−0.32	−0.49	−0.15	2.02	0.155
Provide information on consequences of behaviour to the individual	5 (16)	476 (1291)	−0.51	−0.75	−0.28	−0.33	−0.51	−0.14	1.50	0.221
Prompt rewards contingent on effort or progress towards behaviour	3 (18)	123 (1644)	−0.65	−1.23	−0.07	−0.34	−0.49	−0.19	1.21	0.271
Action planning	6 (15)	339 (1428)	−0.23	−0.53	0.07	−0.41	−0.57	−0.25	1.09	0.296
Set graded tasks	10 (11)	1252 (515)	−0.33	−0.48	−0.18	−0.49	−0.75	−0.22	1.09	0.296
Goal setting (outcome)	3 (18)	123 (1644)	−0.65	−1.23	−0.07	−0.34	−0.49	−0.19	1.04	0.308
Provide information on consequences of behaviour in general	10 (11)	417 (1350)	−0.24	−0.50	0.02	−0.41	−0.61	−0.20	0.96	0.326
Provide instruction on how to perform the behaviour	13 (8)	990 (777)	−0.28	−0.49	−0.08	−0.42	−0.64	−0.20	0.83	0.362
Motivational interviewing	3 (18)	156 (1611)	−0.19	−0.58	0.19	−0.38	−0.55	−0.22	0.78	0.376
Barrier identification/problem-solving	15 (6)	1016 (751)	−0.44	−0.61	−0.26	−0.31	−0.61	−0.01	0.55	0.457
Use of follow-up prompts	14 (7)	989 (778)	−0.47	−0.65	−0.29	−0.15	−0.45	−0.21	0.16	0.693
Provide feedback on performance	7 (14)	336 (1431)	−0.31	−0.61	−0.01	−0.37	−0.55	−0.19	0.12	0.730
Teach to use prompts/cues	4 (17)	231 (1536)	−0.42	−0.86	0.03	−0.35	−0.51	−0.19	0.08	0.784
Relapse prevention/coping planning	11 (10)	543 (1224)	−0.33	−0.56	−0.10	−0.37	−0.58	−0.15	0.05	0.828
Modes of delivery										
Theory based	16 (3)	1638 (129)	−0.38	−0.53	−0.23	0.03	−0.40	0.47	3.07	0.080
Individual and group contact	3 (18)	78 (1689)	−0.77	−1.55	0.00	−0.32	−0.46	−0.18	1.26	0.261
Group contact	5 (16)	203 (1564)	−0.17	−0.53	0.20	−0.37	−0.55	−0.19	0.92	0.338
Supervised	8 (13)	817 (950)	−0.26	−0.51	−0.01	−0.39	−0.58	−0.19	0.57	0.450
Pedometer use	8 (13)	377 (1390)	−0.24	−0.52	0.03	−0.37	−0.55	−0.18	0.52	0.471
Individual contact	12 (9)	1428 (339)	−0.33	−0.52	−0.14	−0.33	−0.63	−0.03	0.00	0.985

would be an optimal approach in the following circumstances: patients who lack confidence for participation in more intensive or supervised activities; [9] patients who report poor adherence to dietary change or first-round medication; [10] and patients who experience side effects of medication that contributes to non-adherence [11].

Much attention is given to the translation of well-resourced proof of principle studies (e.g. Look Ahead) into everyday clinical care [12]. The present analyses take steps towards understanding how complex interventions may be optimised by identifying specific behaviour change techniques and other intervention features for use in routine clinical practice. Furthermore, the analyses show that counselling and resource burden can be reduced by focusing on behavioural strategies with a more robust evidence base. However, there is an urgent need for the field to explore the evidence underpinning how behaviour is changed and the needs of individual patients.

Notwithstanding the value of our findings, they are not without limitation. Studies utilised both subjective and objective methods of free-living physical activity assessment. Moreover, it was not possible to establish the type, intensity and frequency of physical activity attributable to the effect sizes observed. Future work could utilise factorial designs to further understand how behaviour change techniques impact on the type, intensity and duration of physical activity that is maximally effective for sustaining improved clinical outcomes in adults with Type 2 diabetes as a function of stage on the life course.

In summary, physical activity is a viable self-management option for people with Type 2 diabetes [4]. Our findings indicate that use of five behaviour change techniques may facilitate people with Type 2 diabetes to traverse the behavioural–physiological/biochemical gap. Experimental research is warranted in applied clinical settings to elucidate the maximally effective combinations, sequencing and delivery of behaviour change techniques within behavioural interventions in diabetes care. However, the data presented suggest that clinical care teams can optimise their consultations by incorporating specific evidence-based behaviour change techniques that are context appropriate and sensitive to the needs of people with Type 2 diabetes.

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Competing interests

None declared.

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