Outcomes of a community-based lifestyle programme for adults with diabetes or pre-diabetes

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ABSTRACT

INTRODUCTION: Diabetes, a long-term condition increasing in prevalence, requires ongoing healthcare management. Exercise alongside lifestyle education and support is effective for diabetes management.

AIM: To investigate clinical outcomes and acceptability of a community-based lifestyle programme for adults with diabetes/prediabetes at programme completion and 3-month follow-up.

METHODS: The 12-week community programme included twice-weekly sessions of self-management education and exercise, supervised by a physiotherapist, physiotherapy students and a nurse. Clinical outcomes assessed were cardiorespiratory fitness, waist circumference, exercise behaviour and self-efficacy. A standardised evaluation form was used to assess programme acceptability.

RESULTS: Clinically significant improvements were found from baseline (n = 36) to programme completion (n = 25) and 3-months follow-up (n = 20) for the six minute walk test (87 m (95%CI 65–109; $p \leq 0.01$), 60 m (95%CI 21–100; $p \leq 0.01$)), waist circumference (–3 cm (95%CI –6 to –1), –3 cm (95%CI –6 to 1)), exercise behaviour (aerobic exercise 53 min/week (95%CI 26 to 81; $p \leq 0.01$), 71 min/week (95%CI 25 to 118; $p \leq 0.01$)) and self-efficacy (0.7 (95%CI –0.2 to 1.6), 0.8 (95%CI 0.04 to 1.5)). Good programme acceptability was demonstrated by themes suggesting a culturally supportive, motivating, friendly, informative atmosphere within the programme. The attrition rate was 30% but there were no adverse medical events related to the programme.

DISCUSSION: The programme was safe and culturally acceptable and outcomes demonstrated clinical benefit to participants. The attrition rate was largely due to medical reasons unrelated to the programme. This model of a community-based lifestyle programme has the potential to be reproduced in other regions and in adults with similar long-term conditions.

KEYWORDS: Diabetes Mellitus Type II; Prediabetic state; Co-morbidity; Exercise; Self-management

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Introduction

Diabetes and prediabetes prevalence in New Zealand is high and predicted to rise.[1] Multimorbidity in people with diabetes is also high,[2] requiring complex healthcare management and effective inter-professional collaboration.[3]

A Ministry of Health priority is to provide 'better, sooner, more convenient care' including services to help prevent diabetes onset and management,[4] and services targeted towards high risk communities including Māori, Pacific and people with high socio-economic deprivation. Exercise in combination with dietary change is well known to help prevent the onset of diabetes from prediabetes[5–7] and to help in disease control.[8] Learning and adopting better self-management skills are also important in controlling diabetes and lowering hospital admissions.[9,10] Although the benefits of exercise are well known, in the United States only 36% of people with diabetes engage in regular exercise compared to the national average of 58% (data for New Zealand are unknown.)[11]

Key barriers to exercise uptake in people with diabetes and prediabetes include lack of time, lack of motivation, cost of transport and limited facilities.[12] In an Australian community-based study group exercise (n = 28) was more effective at glycaemic control (HbA1c) than home-based exercise (n = 29) in people with diabetes (–0.4% versus –0.1%). Differences were explained by greater exercise adherence associated with additional supervision and group interaction the community facility provided,[13] and self-management skills aiding group-based, patient-centred education.[9]

Although not specific to diabetes patients, the 'green prescription', a written exercise prescription for sedentary patients, has been widely implemented throughout New Zealand primary care and has produced improvements in levels of physical activity and quality of life for adults aged 40–79.[14] Group based exercise[15] and self-management interventions[16] have been explored in high risk communities (including Māori and Pacific) with diabetes and prediabetes with promising results. In New Zealand no programme run collaboratively (with physiotherapist, nurse, dietitian, pharmacist and podiatrist trainers), combines an exercise and self-management education intervention for people with diabetes and prediabetes. The School of Physiotherapy, University of Otago, has established a 12-week community-based lifestyle programme for adults with diabetes and prediabetes, and associated multi-morbidities, combining group-based self-management education with circuit style exercise, in a culturally safe and supportive environment. The programme has been systematically developed, improved and qualitatively evaluated over time.[17] This study investigates the clinical outcomes for participants at programme completion and 3-months follow-up, and the acceptability of the programme to participants in an early cohort.

WHAT GAP THIS FILLS

What is already known

- Healthy lifestyle advice (diet and exercise) and support are important in diabetes/prediabetes condition management. There are many barriers associated with engaging in positive lifestyle changes. Simple advice is not sufficient.
- There is a shortage of specialist diabetes healthcare professionals.
- Adults with diabetes often have multimorbidity which requires complex management.

What this study adds

- Physiotherapists have a key role to play in complex diabetes management within primary health care teams by providing services based on supported exercise and education to help people make positive lifestyle changes.
- This programme is a model for evidence based lifestyle advice and ongoing support that could be implemented widely within primary care.

Methods

Design

We undertook a prospective observational study of an intervention, with no parallel control, with baseline and repeated quantitative outcome measures and supportive qualitative data collection on acceptability. Participants were recruited from local health centres, the regional branch of Diabetes New Zealand and local Māori and Pacific health providers. Participants received twice weekly education and exercise, led by a physiotherapist and student physiotherapists and with the support of a primary health care nurse and other health professionals. Measures were taken at baseline (Week 0), programme completion (Week 12) and three month follow-up (Week 26) by the physiotherapist and nurse (Figure 1).

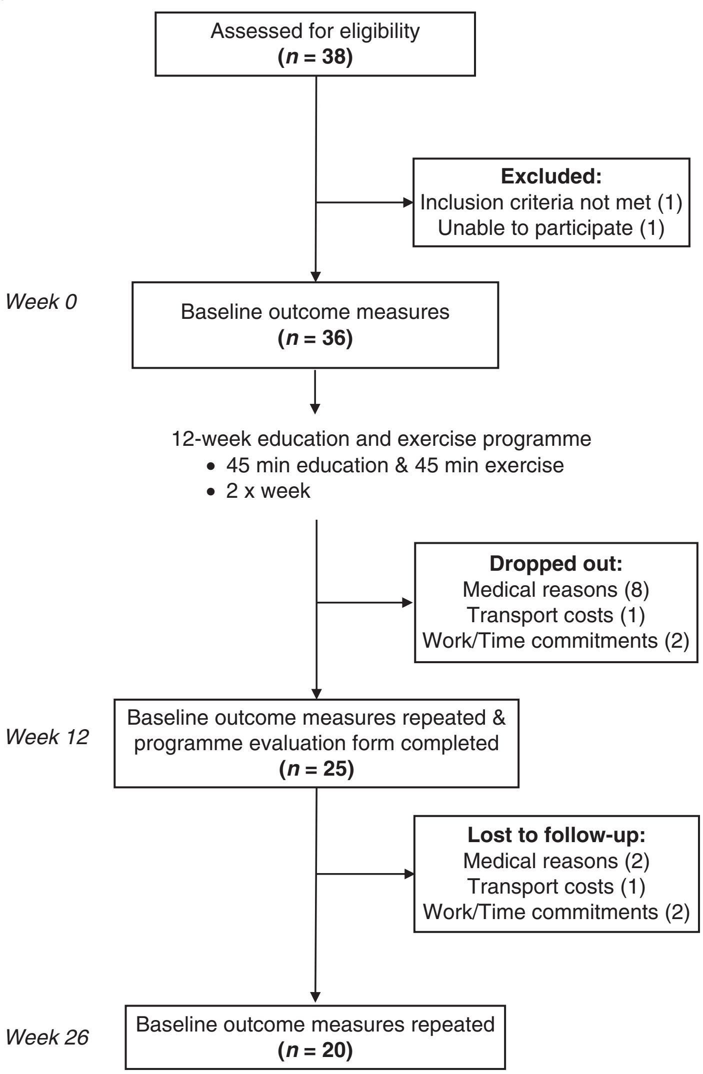
This study was approved by the School of Physiotherapy Human Research Ethics Committee. Participants gave written informed consent and their general practitioners (GPs) provided medical clearance and summary clinical notes, including blood results.

Participants

Inclusion criteria: medically stable; diagnosis of diabetes (Type II; HbA1c reading of 50 mmol/mol) or prediabetes (41–49 mmol/mol) or assessed using the diabetes risk assessment tool[18] as having high risk of developing diabetes in the next five years; and able to understand simple instructions, independently or with assistance from their support person.

Exclusion criteria: cardiovascular problems (including unstable angina, resting systolic blood pressure > 180 mmHg or resting diastolic blood pressure > 100 mmHg)[19] that limited safe participation in aerobic or resistance exercise (nurse assessed); and/or unable to walk 30 m independently with or without a walking aid (physiotherapist assessed).

Figure 1. Diagram showing the flow of participants through to the completion of the study and those lost to follow up



Intervention

Participants attended a maximum of two 90-min sessions per week for 12 weeks. Research has shown greater improvement when programmes include > 18 h of education spread over a longer period of time, totalling at least 10 sessions.[20] Sessions comprised 45 min of education on a variety of health-related topics, then 45 min of exercise. The education sessions (Table 1) were conducted by the physiotherapist or nurse or by other health professionals, including a community diabetes dietitian, a pharmacist, a podiatrist and a diabetes nurse specialist. The dietitian and diabetes nurse specialist are staff typically involved in diabetes group self-management education.[9] The physiotherapist, pharmacist and podiatrist were included in recognition of the evolving inter-professional healthcare environment and an understanding of the diabetes self-management core curriculum.[21,22] All health professionals had received training in self-management education.

Exercise sessions included 5 min aerobic exercise warm-up; 30 min moderate intensity (Borg Rating of Perceived Exertion 12–14)[23] aerobic and resistance exercise circuit, focusing on the major muscle groups of the upper and lower limb, followed by 5 min upper and lower limb flexibility exercises. Exercises were individually prescribed and progressed by increasing repetitions and then increasing resistance over the 12 weeks. Participants could bring a family member, whānau, or friend along for support and participants' attendance was recorded.

Outcome measures

GPs provided demographic and clinical information (age, ethnicity, sex, long-term medical classifications and long-term medications). Measurement of HbA1c level is the gold standard measure of diabetes and prediabetes control[24] and the chosen outcome measure for a specifically designed feasibility study however this study was derived from

Table 1. Timetable for the 12-week education programme highlighting topics and presenters

Week	Tues Topic	Presenter	Thurs Topic	Presenter
1	Introductions & Initial Assessment	*Physiotherapist* *Nurse* *Physiotherapy Student*	Further Assessment	*Physiotherapist* *Nurse* *Physiotherapy Student*
2	Goal Setting	*Physiotherapist* *Nurse* *Physiotherapy Student*	Benefits of Exercise	*Physiotherapist* *Physiotherapy Student*
3	Understanding Blood Pressure	*Nurse*	Medication Question & Answer (i)	*Pharmacist*
4	Home Exercise Programme	*Physiotherapist*	Medication Question & Answer (ii)	*Pharmacist*
5	Label Reading	*Dietitian*	Diabetes Education (i)	*Diabetes Nurse Educator*
6	Healthy Recipes	*Dietitian*	Halfway review	*Physiotherapist* *Nurse* *Physiotherapy Student*
7	Oral Health	*Dental School*	Smokefree 2025	*Smokefree Co-ordinator*
8	Understanding Cholesterol	*Nurse*	Diabetes Education (ii)	*Diabetes Nurse Educator*
9	Pain Management	*Physiotherapist* *Physiotherapy Student*	Heart Health	*Health Educator* *Heart Foundation*
10	Mind and Body Wellness	*Mental Health* *Nurse Educator*	Healthy Feet	*Podiatrist*
11	Arthritis Q & A	*Arthritis Educator* *Arthritis New Zealand*	Portion Sizes	*Dietitian*
12	Final Assessments	*Physiotherapist* *Nurse* *Physiotherapy Student*	Healthy Lunch	*Everyone*

a community clinical service so funding for blood tests to record HbA1c was not available.

Clinical benefit was determined by standardised measures of cardiorespiratory fitness, waist circumference, exercise behaviour and self-efficacy at each of the three time points. The six minute walk test (6MWT)[25] was used to measure cardiorespiratory fitness, as it has been shown in older adults[26] and people with multi-morbidity, including cardiovascular disease, chronic obstructive pulmonary disease, and diabetes[27,28] to have good concurrent validity with cycle ergometry as a measure of cardiorespiratory fitness.[29,30] The minimal clinically important difference for the 6MWT is ~50 m in an older adult population with multimorbidity.[31,32] Exercise behaviour was assessed using the Stanford Exercise Behaviour questionnaire,[33] with a particular focus on the time per week spent in aerobic and strengthening exercise. Self-efficacy for managing diabetes and prediabetes was measured using the Stanford Self-Efficacy for Managing Chronic Disease 6-item Scale. This measure gives a mean score out of 10, with higher numbers indicating better self-efficacy.[34]

Programme acceptability was determined by self-completion of a paper written evaluation form with open-ended questions. Adherence was monitored by recording attendance and attrition determined by the physiotherapist following telephone discussion on their reasons for non-attendance with participants who ceased attending.

Data analysis

Quantitative data were examined with respect to change, from baseline (Week 0) to post-intervention (Week 12) and from baseline to 3 months follow up (Week 26). Results were reported as mean (standard deviation (s.d.)), mean difference (95% confidence interval (CI)) and effect size (Cohen's *d*). Effect size was calculated using the mean and s.d. with 0.2, 0.5 and 0.8

considered small, medium and large effect sizes respectively.

Qualitative data were analysed using thematic analysis.[35] On multiple readings the research team developed themes, subthemes, and categories from reading the statements and coded them independently then by consensus.

Results

Demographics

Thirty eight potential participants were assessed for eligibility. Two were excluded: one did not meet the inclusion criteria and the other was excluded due to work commitments. The mean age of the 36 participants was 62 years (s.d. 11 years), all were

Table 2. Demographics and characteristics of participants at baseline, Week 12 and Week 26 and those lost to follow up

Characteristic	Week 0	Week 12		Week 26	
	Included	Completed	Lost to follow up*	Completed	Lost to follow up§
	(*n* = 36)	(*n* = 25)	(*n* = 11)	(*n* = 20)	(*n* = 5)
Age (*year*), mean (SD)	62 (11)	65 (11)	54 (8)	65 (10)	62 (15)
Sex, number male (%)	15 (42)	10 (40)	5 (45)	7 (35)	3 (60)
Ethnicity, number (%)					
NZ European	23 (64)	17 (68)	6 (55)	13 (65)	4 (80)
Māori	8 (22)	5 (20)	3 (27)	4 (20)	1 (20)
Pacific	4 (11)	2 (8)	2 (18)	2 (10)	0 (0)
Asian	1 (3)	1 (4)	0 (0)	1 (5)	0 (0)
Body Mass Index (*kg/m²*), mean (SD)	35.7 (9.0)	34.2 (6.9)	39.3 (12.1)	35.1 (7.4)	30.3 (2.1)
Morbidity, number (%)					
Diabetes / prediabetes only	5 (14)	4 (16)	1 (9)	4 (20)	0 (0)
Multimorbidity including diabetes / prediabetes	31 (86)	21 (84)	10 (91)	16 (80)	5 (100)

* Eight due to medical reasons.
§ Two due to medical reasons.

Table 3. Mean (s.d.) at each assessment time and mean (95% CI) difference and effect size between assessment times

Outcome	Time			Difference between times	Difference between times
	Week 0	Week 12	Week 26	Week 12–0	Week 0
	(*n* = 36)	(*n* = 25)	(*n* = 20)	(*n* = 25)	(*n* = 36)
Six minute walk test (*m*)	420 (104)	529 (109)	507 (124)	87* (65 to 109) *d* = 1.02	420 (104)
Waist circumference (*cm*)	120 (22)	113 (19)	115 (19)	–3† (–9 to –1) *d* = –0.34	120 (22)
Exercise behaviour Aerobic (*min/week*)	81 (105)	124 (93)	146 (112)	53* (26 to 81) *d* = 0.43	81 (105)
Exercise behaviour Stretch/strengthen (*min/week*)	20 (300)	44 (44)	70 (59)	29* (12 to 47) *d* = 0.11	20 (300)
Self–efficacy (*0–10*)	6.4 (2.3)	7.3 (1.7)	7.7 (1.5)	0.7 (–0.2 to 1.6) *d* = 0.45	6.4 (2.3)

* *p* value (≤0.01).
† *p* value (≤0.05).
d = Cohen's *d*.

overweight or obese and had multiple morbidities (shown in Table 2); 58% were female, 12 (33%) identified as being of Māori or Pacific ethnicity.

Clinical Benefit

Data for all outcomes at each stage are presented in Table 3. The 6MWT demonstrated both clinically and statistically significant changes at Week 12 (+87 m) and Week 26 (+60 m) with a large effect size. Waist circumference demonstrated both a clinically and statistically significant change at Week 12 with a small effect size and a clinically significant change remained at Week 26. There was a mean increase in self-efficacy at both Week 12 (+0.7) and Week 26 (+0.8). Although this represents a clinically meaningful change (0.5 on the Stanford Self-Efficacy for Managing Chronic Disease Scale) and a medium effect size this was not statistically significant. Minutes spent performing both aerobic and stretch or strengthening exercises significantly increased at Week 12 and remained at Week 26.

Acceptability

Two themes emerged: 'Social support' and 'Self-management' (Table 4). The theme 'social support' developed from the relationships made between the staff, physiotherapy students and participants; 'self-management' developed from the increased motivation, confidence, safety and empowerment provided by the programme. Overall, there was minimal negative feedback.

Programme adherence/attrition

A 70% adherence rate was achieved; 385 of a possible 550 programme sessions were attended (25 participants × 22 sessions) (2 sessions were cancelled, one due to the Easter Holiday, the other due to snow making transport unsafe). Eleven participants (30%) dropped out: unrelated medical reasons - cancer diagnosis, total knee replacement, fractured foot from a fall, blood infection and an uncontrolled mental health condition were the most common reasons ($n = 8$), followed by work commitments ($n = 2$) and transport costs ($n = 1$). No adverse events were reported.

Discussion

Summary

Results suggested there was a clinical benefit from mean improvement of cardiorespiratory fitness, waist circumference, exercise behaviour and self-efficacy, all outcomes relevant to diabetes/prediabetes condition management. This clinical benefit remained at 3-months post programme (Week 26). Further, the programme maintained 33% Māori and Pacific ethnicity representation and overall good adherence. Participants were satisfied with the programme, particularly the supportive environment created from the therapeutic relationships developed, which engendered improved self-management strategies.

Clinical Benefit

Mean 6MWT showed a clinically significant increase (>50 m) at Week 12 and Week 26. An improvement in cardiorespiratory fitness is associated with an improvement in diabetes control,[36–38] and reduction in diabetes risk.[39] Results compared favourably with previous studies that applied the 6MWT as a primary outcome measure in lifestyle interventions for older adults with multi-morbidity.[27,28]

Although mean waist circumference decreased 3 cm (95% CI –6 to –1) at Week 12 and was maintained at Week 26 (95% CI –6 to 1), the wide confidence intervals reduce the ability to make inferences. Waist circumference is a modifiable cardio-metabolic risk factor for diabetes and prediabetes[40,41] and 3 cm reduction in waist circumference has a significant benefit on cardio-metabolic risk factors in women with prediabetes[42] and men with diabetes or prediabetes.[43] Thus the 3 cm reduction found in this study is indicative of a decreased cardio-metabolic risk which is considered clinically beneficial for people with diabetes.[24]

Self-efficacy in disease management improved post-programme at Weeks 12 (+0.7) and 26 (+0.8). The level of change suggests a clinical benefit. Studies with greater power than the present study report an increase of 0.5 as clinically beneficial following self-management interventions in populations with multi-morbidity

Table 4. Themes, categories and coded statements from the thematic analysis of the responses to the questionnaire that were used to determine acceptability

Theme: Social support	
Category:	**Coded statement:**
Participants	'The way you meet people, friendship and fellowship with one another'
	'Togetherness with other humans with a common purpose'
	'Sociability'
	'Getting involved with the positive reinforcement the community setting provided'
	'I enjoyed being with the people in the programme'
	'Interaction with participants who have the same symptoms as myself'
Staff	'The friendly encouraging atmosphere'
	'The non-judgemental attitude – we are all hard enough on ourselves'
	'Staff - Warm and supportive personalities'
	'Understanding educators'
	'Friendly support of the staff'
Students	'Found students helpful and considerate'
	'The help given by students with various exercises'
Theme: Self-Management	
Category:	**Coded statement:**
Motivation	'Makes you want to do more exercise, keeps motivation'
	'Motivates me to be fit and healthy'
	'It got me motivated to actually attend something in the community'
	'Encouraged me to help myself'
Confidence	'Learning how to exercise safely and proudly!'
	'Being able to do the exercises which at first I thought I wouldn't be able to manage'
Safety	'Exercise awareness'
	'Assistance in understanding the most effective exercise for specific muscle groups with correct form'
Empowerment	'I found out a whole lot of info that has helped me to make better informed decisions'
	'I learnt lots of good things about how to look after my health'
	'I am the person who can improve my health outcomes'

and the medium to large effect sizes reported were similar to those in the present study.[34,44,45] Improved diabetes self-management skills are known to positively influence clinical, lifestyle and psychosocial outcomes in people with diabetes and prediabetes.[9,16,20]

Mean data from the self-reported exercise behaviour questionnaire suggested both statistically and clinically significant mean increases in minutes per week spent performing aerobic exercise, towards 150 min/week: +53 min/week (95% CI 26 to 81; $p \leq 0.01$) at Week 12, and +71 min/week (95% CI 25 to 118; $p \leq 0.01$) at Week 26. Wide confidence intervals limit inferences about clinical benefit and there is a risk of measurement bias as people have been found to overestimate their exercise levels in self-report questionnaires, particularly people who are obese.[46,47] However, aerobic exercise up to and above 150 min/week has been shown to help to control diabetes and to decrease the risk of developing diabetes in people with prediabetes.[5,48]

Acceptability

The qualitative data informed about programme acceptability and importance of social support and improved self-management skills emerged as key themes. In previous qualitative studies of exercise programmes, social support has been a critical component of acceptability to people with diabetes and prediabetes.[16,49,50] Social support developed from relationships built between the staff, students and participants. Self-management skills strengthened as participants felt more motivated, confident, and safe in the supportive environment and were empowered to engage more with exercise: this may explain the beneficial self-efficacy findings. This empowering process is similar to that suggested by Stevens *et al.*[51] where perceived fitness, social support and self-efficacy contributed towards enjoyment of an exercise programme leading to improved programme adherence and exercise behaviour.

Adherence/attrition

The 70% adherence rate was similar to the pragmatic exercise study by Dasgupta *et al.*[52] in people with diabetes and prediabetes (68%) and Bjorgass *et al.*'s twice weekly 12-week supervised exercise class (77%).[53]

Overall attrition from the programme was 30% (11/36), including five participants lost to follow-up at Week 26. Although this rate appears high, high attrition rates have been reported in other exercise studies in similar populations.[16,54] No adverse events were reported and there was no attrition due to pain or other complications resulting from the exercise. The second most reported reason for attrition was lack of time and difficulty juggling work commitments and the twice-weekly programme. These barriers to exercise have been identified by others.[49,55] The mean age for participants lost to follow-up was 54 years, suggesting these younger participants were still working so flexibility in programme scheduling may be desirable to improve adherence.

Limitations

This study was a pragmatic evaluation of the clinical benefit, acceptability and adherence to an existing diabetes/prediabetes community exercise and education programme, without a control group or blinding of the assessors or participants. Further, a power calculation was not completed because the physical capacity of the venue was limited and as a consequence, so was the number of participants in any one programme. The small sample size therefore limits the strength of statistical and clinical outcomes and conclusions drawn.

Implications

Current New Zealand health policy targets interventions that help prevent and manage the increasing prevalence of diabetes and prediabetes in Māori and Pacific people.[21,56] Māori and Pacific people are low users of New Zealand health services so healthcare provided in a culturally accepted manner is important to aid access.[57,58] A 33% combined representation of Māori and Pacific participants remaining during the 12-week programme and at 3-month follow-up is encouraging, given that Māori and Pacific people comprise 10% of Dunedin's and 22% of New Zealand's population.[59] Māori and Pacific health providers were approached and health professionals running the programme had close working links with the local Māori and Pacific community: this may have contributed to participation, cultural safety and programme adherence.

Conclusion

The 12-week lifestyle programme for adults with diabetes or prediabetes combining exercise and education in a culturally safe and supportive manner was acceptable and associated with positive health outcomes. Providing physiotherapy-led exercise and education in an appropriate community facility facilitated participants engaging with, and supporting others, in a programme modified for their own health needs. Further research into the programme's efficacy and cost-effectiveness is warranted along with a further review of its long-term effectiveness.

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COMPETING INTERESTS
None declared.