Effectiveness of a pragmatic education programme aimed at promoting walking activity in individuals with impaired glucose tolerance: a randomized controlled trial

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Objective: To investigate whether a pragmatic structured education programme with and without pedometer use is effective at promoting physical activity and improving glucose tolerance in those with impaired glucose tolerance.

Research Design and Methods: Overweight and obese individuals with impaired glucose tolerance were recruited from ongoing screening studies at the University Hospitals of Leicester, UK. Participants were randomized to one of three groups. Group one received a three-hour group-based structured education programme aimed at promoting walking activity using personalised steps-per-day goals and pedometers. Group two received a three-hour group-based structured education programme aimed at promoting walking activity using generic time-based goals. Group three received a brief information leaflet (control condition). Outcomes included an oral glucose tolerance test, standard anthropometric measures, ambulatory activity and psychological variables. Follow-up was conducted at 3, 6 and 12 months.

Results: 87 individuals (66% male, mean age 65 years) were included in this study. At 12 months significant decreases in 2-hour post-challenge glucose and fasting glucose of -1.31mmol/l (95% CI -2.20 to -0.43) and -0.32 mmol/l (95% CI -0.59 to -0.03) respectively were seen in the pedometer group compared to the control group. No significant improvements in glucose control were seen in those given the standard education programme.

Conclusions: This study suggests that a pragmatic structured education programme which incorporates pedometer use is effective at improving glucose tolerance in those with impaired glucose tolerance. This is likely to have important implications for future primary care based diabetes prevention initiatives.
Lifestyle interventions programmes have successfully reduced the risk of type 2 diabetes in high-risk individuals in diverse settings (1). However, evaluated diabetes prevention programmes have tended to use resource-intensive behaviour change strategies which may be difficult to implement in usual health care practice given resource and infrastructure limitations (2-3). Furthermore, although physical inactivity is one of the most important lifestyle determinants contributing to the rising prevalence of type 2 diabetes, there is little direct evidence that previous diabetes prevention programmes have been successful at promoting clinically significant increases in physical activity (4). Therefore studies aimed at developing and evaluating pragmatic physical activity interventions in at-risk individuals are needed.

The Prediabetes Risk Education and Physical Activity Recommendation and Encouragement (PREPARE) structured education programme was developed in response to this need. The PREPARE programme is designed to promote walking activity through pedometer use in those with impaired glucose tolerance (5).

The primary aim of this study was to test the hypothesis that the PREPARE programme is effective at improving glucose tolerance in individuals identified with impaired glucose tolerance (IGT) after 12 months. The secondary aim of the study was to test experimentally the role of the pedometer at promoting sustained behaviour change. This is important because the National Institute for Health and Clinical Excellence, UK, guidance on methods to increase physical activity highlights the lack of evidence for pedometer use as an adjunct to existing methods of promoting behaviour change (6).

RESEARCH DESIGN AND METHODS

Patient recruitment: Participants were recruited from ongoing population-based diabetes screening programmes in Leicester, UK, between September 2006 and March 2007; the study was completed in April 2008. Overweight or obese individuals (BMI \( \geq \) 25 Kg/m\(^2\) or \( \geq \) 23Kg/m\(^2\) for South Asians) with screening-detected IGT (7), were contacted by letter and follow-up telephone call by a member of their screening team and invited to take part in the study. Individuals were recruited into the study within 12 months of their screening visit. As part of the screening programmes all individuals had their physical activity levels assessed by the short version of the international physical activity questionnaire (IPAQ) (8). Individuals who reported taking steroids were excluded.

All applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research. This study was approved by the Leicestershire, Northamptonshire and Rutland NHS Research Ethics Committee in June 2006.

Treatment regimens and randomization: Participants were randomized to receive either usual care, the PREPARE programme or the PREPARE programme without pedometer use. Participants were randomized using a block design and stratified by age and sex. Participant randomization was conducted using opaque envelopes and a randomly generated number sequence by a member of our research team with no prior knowledge of recruited individuals, other than their age and sex. Participants were informed of their allocated group by a member of our research team once their baseline measurements were completed.

PREPARE programme: The theoretical underpinning, design and content of the PREPARE programme has been described in detail elsewhere (5). In brief, it is
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a single-session group-based education programme. The programme is 180 minutes long; 105 minutes are dedicated to addressing the causes, complications, timeline and identity of IGT and 75 minutes are targeted at addressing the perceived effectiveness of exercise as a treatment for IGT, walking self-efficacy beliefs, barriers to walking, and self-regulatory strategies. The programme has a written curriculum, modelled on the person-centred philosophy and learning techniques developed for the DESMOND programme (9-11), an established nationally available six-hour structured educational programme aimed at promoting lifestyle change and self-management for those with newly diagnosed type 2 diabetes in the UK.

As part of the programme, participants were provided with a pedometer (SW-200, Yamax Corporation, Tokyo, Japan) and encouraged to set personalized steps-per-day goals based on their baseline ambulatory activity level. Sedentary participants were encouraged to increase their activity levels by at least 3000 steps per day, equivalent to around 30 minutes of walking (12). Those achieving more than 6000 steps per day were encouraged to try to reach at least 9000 steps per day, an amount that is likely to include 30 minutes of walking activity in addition to usual daily activity (12). Those achieving more than 9000 steps per day were encouraged to at least maintain their current activity levels and informed that health benefits could be achieved by increasing their activity levels further. As with the pedometer group, participants were encouraged to set proximal goals, such as increasing moderate-intensity activity by 5 minutes per day every two weeks, form action plans and record their daily activity levels. Individuals wishing to set vigorous-intensity activity goals were advised that they should consult their general practitioner before commencing the programme.

Preparation programme without pedometer use: This group received the PREPARE programme, but instead of receiving pedometers, participants were encouraged to set time-based goals designed to match the advice given to the pedometer group. Sedentary individuals were encouraged to try and achieve at least 30 minutes of moderate-intensity physical activity-per-day. Those already achieving 30 minutes of moderate-intensity physical activity were encouraged to at least maintain their current activity levels and informed that health benefits could be achieved by increasing their activity levels further. As with the pedometer group, participants were encouraged to set proximal goals, such as increasing moderate-intensity activity by 5 minutes per day every two weeks, form action plans and record their daily activity levels. Individuals wishing to set vigorous-intensity activity goals were advised that they should consult their general practitioner before commencing the programme.

Intervention delivery and follow-up: Both versions of the PREPARE programme were delivered by two educators trained through the DESMOND programme. Programmes were delivered at the Diabetes Research Unit, Leicester Royal Infirmary, UK, within one month of baseline measurements. Individuals in both intervention groups also received a brief (10 minute) review of progress during their 3-month and 6-month clinical measurement session delivered by the same educators as the initial educational programme.

Usual care: Participants randomized to the control group were sent a brief information sheet in the post detailing the likely causes, consequences, symptoms and timeline associated with IGT, along with
information about how physical activity can be used to treat/control the condition.

**Measures** - All outcomes were measured at baseline and 3, 6 and 12 months; 2-hour glucose was the primary outcome and all other outcomes were secondary.

**Biochemical:** At their baseline appointments participants underwent an oral glucose tolerance test (fasting and 2-hour glucose). Participants arrived at their appointment after a 12-hour fast and 24 hours of avoiding vigorous exercise. Those diagnosed with type 2 diabetes at baseline were excluded from the study (7). All biochemical analyses were conducted blinded to treatment group.

Plasma glucose was measured using a glucose oxidase method on the Beckman Auto Analyzer (Beckman, High Wycombe, UK). Serum cholesterol was analysed using the cholesterol enzymatic assay (Abbott Clinical Chemistry, IL, USA). High density lipoprotein (HDL) cholesterol was analysed using the ultra HDL assay (Abbott Clinical Chemistry, IL, USA). Serum triglyceride was analysed using the triglyceride glycerol phosphate oxidase assay (Abbott Clinical Chemistry, IL, USA). Biochemical measurements were undertaken in the same laboratory located within Leicester Royal Infirmary using stable methodology standardized to external quality assurance reference values.

**Physical activity:** Physical activity was measured objectively by pedometer and subjectively by questionnaire. Sealed piezoelectric pedometers with a seven-day memory (NL-800, New-lifestyles, USA) were used to measure ambulatory activity. These pedometers were different from the motivational instruments used in the primary intervention condition and have been shown to be more accurate than traditional spring-levered pedometers in overweight and obese individuals (13). For the purposes of this study at least three valid days of data were required; a valid day constituted at least 12 hours of wear time.

Physical activity was also measured using the long last-seven-days self-administered format of IPAQ. This questionnaire provides a measure of walking and other moderate- to vigorous-intensity activities carried out for more than 10 continuous minutes at work, in the home, as transport and during leisure time. IPAQ has been shown to have reasonable validity compared to accelerometer data (ρ = 0.4) and test-retest reliability (ρ = 0.7) in the United Kingdom (8).

**Psychological:** Perceptions and perceived knowledge of impaired glucose tolerance - Perceptions and perceived knowledge of IGT were measured with the validated brief illness perceptions questionnaire (14). This instrument was used to measure five cognitive illness representations (consequences, timeline, personal control, treatment, and symptom load attributed to IGT), two emotional representations (concern and negative emotion affect attributed to having IGT) and perceived knowledge of IGT. Each item was answered using an 11 point Likert scale

**Self-efficacy** - Participants’ confidence in their ability to exercise in the face of five commonly identified barriers (tired, bad mood, bad weather, lack of time and holiday) was measured using an 11 point Likert scale (15).

**Demographic and anthropometric** - Arterial blood pressure was measured in the sitting position (Omron, Healthcare, Henfield, UK); three measurements were obtained and the average of the last two measurements was used. Body weight (Tanita TBE 611, Tanita, West Drayton, UK), waist circumference (midpoint between the lower costal margin and iliac crest) and height were also measured, to the nearest 0.1 kg and 0.5 cm respectively. Information on current smoking
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status, medication history, and ethnicity were obtained by self-report.

**Data analysis** - Based on a power of 80%, a significance of 0.05, and a standard deviation of 1mmol/l and allowing for a 50% drop-out rate (non-completers and those diagnosed with type 2 diabetes at baseline), 34 participants were required per group in order to detect a 1 mmol/l difference in 2-hour glucose levels between each intervention group and control group at 12 months.

Those not attending the final 12-month follow-up measurement session and those diagnosed with type 2 diabetes at baseline were excluded from the analysis. Those diagnosed with type 2 diabetes at 3 months and 6 months (n = 4) were treated according to the screening studies from which they were recruited and had subsequent follow-up data imputed using their last observation carried forwards. In order to have numeric parity across time points, missing biochemical, pedometer, and anthropometric data at 3-months (n = 2) and 6-months (n = 2), resulting from those not attending all intermediary follow-up sessions, were imputed using the next observation carried backwards. All individuals included in the analysis were analysed in the group to which they were assigned.

Between-group comparisons of change in measured outcomes at 3, 6 and 12 months were conducted using analysis of covariance (ANCOVA) procedures; baseline data were included as a covariate. Each intervention group was compared to the control group using simple *a priori* contrasts; as this study had one primary hypothesis, adjustment was not made for multiple group, time or outcome comparisons. Nonetheless secondary outcomes were interpreted with caution and in relation to the overall pattern of results. All variables were checked for normality using the Kolmogorov-Smirnov test and visual inspection after the removal of extreme outliers (a value at least 4 standard deviations from the mean). Tests were two sided; p<0.05 was considered significant. All analysis was carried out on SPSS 14.0 for Windows (SPSS, Chicago, USA)

**RESULTS**

The trial profile is shown in Figure 1. Of 326 individuals invited to take part in the study, 103 (32%) consented. Those who consented to take part had similar levels of self-reported walking and overall physical activity and were of a similar age and ethnicity to those who declined the invitation; however, more men than women agreed to take part (63% of study participants were male compared to 55% of those invited to take part; p = 0.03). Five individuals were excluded from the study at baseline due to a diagnosis of type 2 diabetes. Over the course of the trial three individuals in the control group and one individual in the education group without pedometer use were diagnosed with type 2 diabetes; no cases of diabetes were observed in those given the pedometer version of PREPARE programme. Eleven participants were lost to 12-month follow-up. There were no significant demographic, biochemical or lifestyle differences at baseline between attendees and non-attendees at 12 months.

Baseline demographic, anthropometric, biochemical and lifestyle characteristics of the study participants are shown in Table 1; the majority of participants were inactive based on pedometer counts (12). There was no significant difference between groups in any of the measured variables at baseline; however, levels of self-reported physical activity were substantially, although not significantly, higher in the pedometer group.

**Glucose regulation and physical activity:** Table 2 shows change in measures of physical activity and glucose regulation at 3, 6 and 12 months: the intervention effect for each intervention group is also provided. Two
hour glucose decreased significantly in the pedometer group compared to the control group at 3 months (-1.46 mmol/l; 95% CI -2.36 to -0.56) and 12 months (-1.31 mmol/l; 95% CI -2.20 to -0.43). Fasting glucose also decreased significantly in the pedometer group compared to the control group at 3 months (-0.37 mmol/l; 95% CI -0.63 to -0.11), 6 months (-0.30 mmol/l; 95% CI -0.57 to -0.03) and 12 months (-0.32 mmol/l; 95% CI -0.59 to -0.03). There was no difference in either fasting or 2-hour glucose in those given the education programme without pedometer use when compared to the control group at any follow-up time point.

Objectively measured ambulatory activity and self-reported walking and overall moderate- to vigorous-intensity physical activity increased significantly in the pedometer group compared to the control group at 3, 6 and 12 months. In the group without pedometer use, ambulatory activity and self-reported walking and moderate- to vigorous-intensity physical activity increased significantly compared to the control group at 12 months; however there was no significant increase in any measure of physical activity in this group compared to the control group at 3 or 6 months.

Lipids, blood pressure and body weight: There was no difference in measured blood lipids, body weight, waist circumference or blood pressure in either of the intervention groups compared to the control group at any time point (Online Appendix Table A1 available at http://care.diabetesjournals.org).

Psychological: Compared to the control group, both intervention groups achieved significant increases in perceived knowledge of IGT, perceived effectiveness of exercise as a treatment for IGT and self-efficacy beliefs at 12-months (Online Appendix Table A2). No significant differences were seen in other measured illness perception or emotional representations.

CONCLUSIONS
This study found that group-based structured education aimed at promoting increased walking activity through pedometer use is effective at improving glucose tolerance in those with screening detected IGT, whereas the same programme without pedometer use did not result in improved glucose tolerance.

The decrease in 2-hour glucose seen in the pedometer group at 12-months of -1.31 mmol/l (95% CI -2.20 to -0.43) is greater than that reported in previous lifestyle diabetes prevention programmes. For example a meta-analysis of eight studies reported an overall intervention effect in 2-hour glucose of -0.84 mmol/l (95% CI -1.29 to -0.39) at 12 months and a reduction in relative risk of developing type 2 diabetes of 0.55 (95% CI 0.44 to 0.69) (16). Those in the pedometer group also achieved a significant decrease in fasting glucose of -0.32 mmol/l (95% CI -0.59 to -0.03) compared to the control group; this is in contrast to previous diabetes prevention programmes where lifestyle change has consistently failed to reduce fasting plasma glucose levels(3). However, a recent study in individuals with a family history of type 2 diabetes reported that change in physical activity, as measured by accelerometers, was associated with change in fasting glucose at 12 months (17).

It has been suggested that weight loss was the primary determinant of the reduced risk of developing type 2 diabetes observed in previous lifestyle diabetes prevention programmes (4, 18), in part because these programmes have only demonstrated small increases in physical activity (4). In contrast, although no changes to body weight or waist circumference were observed in this study, substantial increases in ambulatory activity of around 2000 steps per day - equivalent to
around 140 minutes of moderate-intensity walking activity per week (12) - were seen in the pedometer group compared to the control group at each follow-up time point. The results of this study are consistent with numerous mechanisms linking physical activity directly to reduced insulin resistance and improved glucose control (19). In the group given the education programme without pedometer use, the relatively low dose of ambulatory activity at 12-months and/or the lack of sustained increases in physical activity across the study period may explain why glucose levels were unchanged.

The lack of an intervention effect on cholesterol and blood pressure levels is consistent with a study in individuals with a family history of type 2 diabetes, which found that change in overall physical activity, as measured by accelerometers, was significantly associated with reductions in fasting insulin and glucose, but not with blood pressure or HDL-cholesterol, after adjustment for markers of adiposity (17). Another prospective study using objectively measured physical activity energy expenditure reported similar findings (20). The PREPARE programme study adds to this evidence by suggesting that in individuals with IGT, of whom many were taking antihypertensive and/or statin medication, glucose regulation is more sensitive to change than blood pressure or cholesterol with increased physical activity.

Both versions of the PREPARE programme positively influenced several of the key psychological determinants on which the programme was grounded. This suggests that the pedometer was crucial in promoting the self-regulatory strategies needed to convert the motivational impact of the education programme into sustained behaviour change and improved glucose tolerance. This study adds to the evidence from other intervention studies that have consistently shown that pedometer-based programmes are successful at initiating increased ambulatory activity in those with type 2 diabetes and the general population over the short-term (<6months)(21).

This study has several important limitations. Firstly, the small sample size precluded meaningful sub-group analysis, which is important given the heterogeneity of the study sample. Secondly, the study was conducted in a single centre by a dedicated research team; this limits the generalizability of the findings. However, the intervention used in this trial was robustly developed according to established criteria for developing and evaluating complex interventions which included a theory, modelling and exploratory trial phase; therefore this study is reproducible (22). Thirdly the methodology of this study did not allow it to be determined whether the success of the pedometer version of the PREPARE programme was solely or partly due to the reactivity of wearing a pedometer and keeping a daily step count log. However, studies have shown that the reactivity of wearing an open pedometer in adults is minimal and likely to be temporary (23, 24), suggesting that some form of additional support is required to facilitate sustained behaviour change.

These limitations notwithstanding, this study is the first randomized controlled trial to show behaviour change and improve glucose tolerance in individuals with IGT following a pragmatic structured education programme. Traditional diabetes prevention programmes have utilized intensive counselling strategies which would be difficult to deliver in a “real world” health care setting; for example the Finnish Diabetes Prevention Study reported a median of 20 counselling sessions per patient over the 3-year intervention period (25). Therefore pragmatic interventions are required that are compatible with the infrastructure and resources available to national health services. The PREPARE
programme study suggests one possible approach in the UK, not least because it could utilise existing national and regional educator training and quality assurance and development infrastructure that have been developed for delivering type 2 diabetes self-management programmes, such as the DESMOND programme (8-10).

However, larger multi-centred randomised controlled trials are needed to confirm the efficacy and cost-effectiveness of this approach at preventing diabetes 2 diabetes in at-risk populations.

ACKNOWLEDGEMENTS

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Conflict of interest: None of the authors have any conflict of interest to declare.
REFERENCES

Table 1: Clinical, lifestyle and demographic characteristics of study participants overall and by group at baseline.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total (n = 87)</th>
<th>Control (n = 29)</th>
<th>PREPARE (n = 29)</th>
<th>PREPARE with pedometer (n = 29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>65 ± 8</td>
<td>65 ± 10</td>
<td>64 ± 7</td>
<td>66 ± 8</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>57 (66)</td>
<td>17 (59)</td>
<td>20 (69)</td>
<td>20 (69)</td>
</tr>
<tr>
<td>Female</td>
<td>30 (34)</td>
<td>12 (41)</td>
<td>9 (31)</td>
<td>9 (31)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>65 (75)</td>
<td>20 (69)</td>
<td>20 (69)</td>
<td>25 (86)</td>
</tr>
<tr>
<td>South Asian</td>
<td>21 (24)</td>
<td>9 (31)</td>
<td>8 (31)</td>
<td>4 (14)</td>
</tr>
<tr>
<td>Black</td>
<td>1 (1)</td>
<td>0 (0)</td>
<td>1 (3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Blood pressure medication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-blockers</td>
<td>29 (34)</td>
<td>10 (34)</td>
<td>11 (38)</td>
<td>8 (28)</td>
</tr>
<tr>
<td>Ace-inhibitors</td>
<td>17 (20)</td>
<td>5 (19)</td>
<td>4 (14)</td>
<td>8 (28)</td>
</tr>
<tr>
<td>Statins</td>
<td>47 (55)</td>
<td>17 (57)</td>
<td>14 (48)</td>
<td>16 (55)</td>
</tr>
<tr>
<td>Smoking status</td>
<td>8 (9)</td>
<td>5 (17)</td>
<td>2 (7)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Pedometer counts (steps per day)</td>
<td>6681 ± 3462</td>
<td>6873 ± 3537</td>
<td>6560 ± 4424</td>
<td>6600 ± 2402</td>
</tr>
<tr>
<td>Self-reported walking activity (MET-min/wk)</td>
<td>990 [445 to 2123]</td>
<td>801 [292 to 2161]</td>
<td>891 [297 to 2079]</td>
<td>1386 [594 to 2772]</td>
</tr>
<tr>
<td>Total self-reported energy expenditure (MET-min/wk)</td>
<td>2580 [1180 to 4719]</td>
<td>2335 [923 to 3921]</td>
<td>2359 [947 to 3989]</td>
<td>3480 [1524 to 6339]</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>29.2 ± 4.7</td>
<td>29.8 ± 4.4</td>
<td>29.5 ± 4.9</td>
<td>28.7 ± 4.8</td>
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<tr>
<td>Waist circumference (cm)</td>
<td>102 ± 11</td>
<td>103 ± 9</td>
<td>103 ± 11</td>
<td>99 ± 12</td>
</tr>
<tr>
<td>Weight</td>
<td>80.8 ± 15.1</td>
<td>81.1 ± 15.0</td>
<td>81.9 ± 14.2</td>
<td>79.4 ± 16.4</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>142 ± 16</td>
<td>141 ± 15</td>
<td>144 ± 17</td>
<td>139 ± 15</td>
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<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>81 ± 9</td>
<td>81 ± 10</td>
<td>82 ± 8</td>
<td>79 ± 10</td>
</tr>
<tr>
<td>2-hour Glucose (mmol/l)</td>
<td>8.4 ± 2.0</td>
<td>8.4 ± 2.1</td>
<td>8.1 ± 1.8</td>
<td>8.8 ± 2.2</td>
</tr>
<tr>
<td>Fasting glucose (mmol/l)</td>
<td>5.6 ± 0.6</td>
<td>5.7 ± 0.5</td>
<td>5.6 ± 0.6</td>
<td>5.6 ± 0.5</td>
</tr>
<tr>
<td>Total cholesterol (mmol/l)</td>
<td>4.7 ± 1.0</td>
<td>4.7 ± 0.9</td>
<td>4.8 ± 1.0</td>
<td>4.7 ± 1.1</td>
</tr>
<tr>
<td>HDL-cholesterol (mmol/l)</td>
<td>1.3 [1.1 to 1.4]</td>
<td>1.3 [1.1 to 1.5]</td>
<td>1.3 [1.1 to 1.5]</td>
<td>1.2 [1.1 to 1.4]</td>
</tr>
<tr>
<td>Triglycerides (mmol/l)</td>
<td>1.3 [1.0 to 1.8]</td>
<td>1.2 [1.0 to 1.7]</td>
<td>1.3 [0.9 to 1.7]</td>
<td>1.4 [0.8 to 1.9]</td>
</tr>
</tbody>
</table>

Categorical data presented as number (column percent), parametric continuous data as mean ± SD and non-parametric data as median [interquartile range]
Table 2. Change from baseline and the associated intervention effect for glucose and physical activity measurements at 3, 6 and 12 months

Data displayed as mean (95% confidence interval)
All reported intervention effects were adjusted for baseline value.
* = number of available datasets after excluding missing or invalid data and extreme outliers
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Figure 1: PREPARE programme study profile

- 326 invited to take part
- 33 allocated to the PREPARE + pedometer group
  - 1 unable to attend the intervention due to work commitments
- 31 allocated to the PREPARE group
  - 2 unable to attend the intervention due to work commitments
- 103 consented
  - 5 diagnosed with type 2 diabetes at baseline
  - 98 randomly assigned
- 32 completed 3-month follow-up
  - 2 diagnosed with type 2 diabetes and withdrawn from the trial
- 2 lost to 3-month follow-up
  - 1 on holiday
  - 1 family illness
- 5 lost to 12-month follow-up
  - 1 on holiday
  - 1 family illness
  - 2 work commitments
- 29 completed 3-month follow-up
  - 1 diagnosed with type 2 diabetes and withdrawn from the trial
- 3 completed 6-month follow-up
  - 1 unwilling to attend
  - 1 unable to contact
  - 1 illness
- 33 completed 3-month follow-up
- 33 completed 6-month follow-up
  - 2 moved away
- 28 completed 6-month follow-up
  - 1 unwilling to attend
  - 1 unable to contact
  - 1 work commitments
- 29 completed 6-month follow-up
  - 3 additional individuals had 12-month data imputed as a result of being withdrawn from the trial due to a diagnosis of diabetes
- 28 completed 12-month follow-up
  - 1 unwilling to attend
  - 1 holiday
  - 1 unable to contact
  - 1 work commitments
- 26 completed 12-month follow-up
  - 1 additional individual had 12-month data imputed as a result of being withdrawn from the trial due to a diagnosis of diabetes
- 28 completed 12-month follow-up
  - 1 unwilling to attend
  - 1 unable to contact
  - 1 work commitments
- 29 completed 12-month follow-up
  - 3 additional individuals had 12-month data imputed as a result of being withdrawn from the trial due to a diagnosis of diabetes