Quantity and specificity of action-plans as predictors of weight loss

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Quantity and specificity of action-plans as predictors of weight loss: analysis of data from the Norfolk Diabetes Prevention Study (NDPS)

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Abstract

Objective

Investigate associations between quantity, content and specificity of action-plans and weight loss in a diabetes prevention study.

Design

Prospective cohort study nested within a randomised controlled trial. Participants completed action-planning worksheets during intervention sessions.

Main outcome measures

Action-plans were coded in terms of: number of plans set, their content, and specificity. Multivariate regression analyses assessed associations with weight loss at four-months.

Results

890 planning-worksheets from 106 participants were analysed. Participants wrote a mean of 2.12 (SD = 1.20) action-plans per worksheet, using a mean of 2.20 (SD = 0.68) specificity components per action-plan. Quantity of action-plans per worksheet decreased over time (r = −0.137, $p < 0.001$) and increased quantity was associated with reduced specificity [r = −.215, $p < 0.001$]. Walking (34.9% of action-plans) and reducing high fat/sugar snacks (26.1%) were the most commonly planned lifestyle actions. In multivariate modelling, increased quantity of action-plans was associated with greater weight loss (R2 = 0.135, Unstandardised Beta = 0.144, $p = 0.002$). Specificity was not significantly associated with weight-loss ($p = 0.096$).

Conclusion

Producing more action-plans was associated with greater weight loss. Further research should directly compare more versus less specific action-plans and explore ways to sustain engagement in action-planning. Our findings imply that participants should freely set numerous action-plans, rather than being encouraged to focus on specificitySupplemental data for this article is available online at https://doi.org/10.1080/08870446.2022.2055026 .

Keywords: Action planning; quantity; specificity; type 2 diabetes; weight loss

Introduction AQ1

It is well known that poor diet, lack of physical activity and consequent weight gain have negative effects on health (Kennedy et al., 2008; WHO, 2020). Obesity is a major contributor to the rising prevalence of non-communicable diseases and early mortality (Adams et al., 2006; Antonino De Lorenzo et al., 2019), and is of growing scientific, social, and political interest (Antonio De Lorenzo et al., 2020). In particular, the obesity epidemic is driving the increased prevalence of type 2 diabetes (Wilding, 2014). Evidence from observational studies and randomised trials suggest that type 2 diabetes can develop in individuals parallel to weight gain, with figures estimating that 85–90% of people with type 2 diabetes are overweight or obese (Menke et al., 2015). To prevent type 2 diabetes, lifestyle change is therefore vital. Evidence from international randomised controlled trials of lifestyle interventions, which encourage people at risk of developing diabetes (sometimes called 'prediabetes'), to lose weight, adopt a healthy diet, and increase physical activity, can significantly decrease the incidence of type 2 diabetes (Diabetes_Prevention_Program_Research_Group, 2002; Knowler et al., 2002; Kosaka et al., 2005; Sampson, 2021; Tuomilehto et al., 2001).

Individual level interventions to promote changes in diet and physical activity have often centred on supporting self-regulation (Carver & Scheier, 2001) and the process of planning is central to this (Bailey, 2019; Sniehotta et al., 2005a; van Osch et al., 2009). Despite comprehensive definitions (Michie et al., 2013), the terms 'implementation intentions' and 'action-planning' are often used interchangeably and there are no agreed uniform definitions of a 'goal' or a 'plan' (Copeland et al., 2017). In this paper, we focus on action planning defined as engaging in detailed planning relating to performance of the target behaviour (Michie et al., 2013), which variously refers to when, where and how to act (Leventhal et al., 1965), what one will do (Verplanken & Faes, 1999), who one will perform a behaviour with (Luszczynska, 2006; Luszczynska et al., 2007a) and may also include reference to context, frequency, duration and intensity (Michie et al., 2013). For example, a plan of; 'On Tuesday after work I will go running at the gym with Helen' can be considered more specific than the plan 'On a weekday evening, I will do some sport'. Implementation intentions (Gollwitzer & Brandstätter, 1997) can also be used to make plans more specific by linking a critical condition or cue, to a response in a contingent 'If-Then' format (Duhne et al., 2020). The if-then structure is most often used in planning how one might respond to challenges ahead of time to maintain behaviour change, by identifying specific triggers or barriers (If) and developing strategies to overcome those (Then) as part of problem solving or coping planning (Bélanger-Gravel et al., 2013; Sniehotta et al., 2005b; Ziegelmann et al., 2006). Action plans could be viewed as facilitating behaviour change in a similar way, with the cue to act or 'if' part of the plan represented by the 'when' and 'where'; and the 'then' part of the plan or the behavioural response represented by the 'how' (van Osch et al., 2010). However, it is worth noting that using an implementation intention If-Then format to set an action plan using situational ('when' and 'where') and response cues, is not the same conceptually as setting a specific action plan using all characteristics of where, what, when and who with, all relating to the definition of the target behaviour. It is the latter type of action plans and specificity within plans that we focus on here.

Conceptual reviews, randomised controlled trials and meta-analysis research evidence have reported positive associations between the use of action planning (alongside other intervention techniques) and dietary and physical activity behaviour change (Bélanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006; Swann et al., 2020) and weight loss outcomes (Benyamini et al., 2013; Luszczynska et al., 2007b). Most studies have evaluated the effects of forming plans on behaviour change using experimental designs comparing impacts on behaviour or other outcomes in an intervention group in which people formed them versus a control group in which they did not. Such studies evaluating the use of action planning in isolation (Benyamini et al., 2013; Luszczynska et al., 2007a, 2007b; Pfeffer & Strobach, 2020), often only measure self-reported levels of participant engagement in action-planning using Likert-type questionnaire responses (Ayyoub et al., 2017; Pfeffer & Strobach, 2019) and do not use raw action plan data to directly assess action plan features such as quantity or specificity. Research exploring action-plan content from dietary and physical activity action-planning interventions is sparse and few studies assess the number of action plans set by participants, and how these link to health outcomes (Fleig et al., 2017).

Although research is limited, evidence from randomised controlled trials does support that forming more action-plans is associated with better outcomes, specifically for healthy eating and physical activity (Mistry et al., 2015; Wiedemann et al., 2011, 2012). A common obstacle when attempting to assess effects of the quantity of action-plans on outcomes is adherence to intervention instructions. Estimates vary greatly, ranging from studies reporting 63% of participants adhering to the intervention protocol and forming a 'plan' when instructed (Michie et al., 2004; Skår et al., 2011), to other studies reporting that 62.5% of participants formed no action-plan at all (Wiedemann et al., 2011). However, Wiedemann et al. (2011) applied strict definitions on whether a plan was counted or not. Plans were only counted if each component was specified, if the specifications were action-relevant (i.e. plan quality was assured), and only if the components matched, as non-completion or misspecification would lead to underestimated effects of planning. These authors also note that the high proportion of participants not formatting plans may be explained by the fact that many participants were already in the action stage of change and did not need to specify a new action plan, but rather, they used coping planning instead as it matched their stage of change (to support maintenance of behaviour change). In an attempt to address low adherence rates, some researchers have instructed participants to set a specific number of action-plans Wiedemann (Wiedemann et al., 2011) asked participants to form up to three action plans and three coping plans, and reported a significant positive association between quantity of action plans and physical activity outcomes, although this relationship was not linear, with those participants forming two action-plans engaging in more physical activity than those participants who formed three. Webb (2006) proposed that forming multiple plans may be counterproductive due to the higher cognitive load at the planning stage. Taken together with the sparsity of evidence outlined above, further investigation is needed to better understand the relationship between the quantity of action-plans set and health outcomes.

Recent research in this area has also focused on 'specificity' as a key construct relating to action-plan content (Keller et al., 2017). Evidence suggests that by anticipating and planning the link between situational cue detail, such as 'when' or 'where' and the desired response, for example 'how' details, specific action planning triggers automatic, habitual behaviours, which when repeated over time, increases the likelihood of the desired behavioural outcome being achieved (Gollwitzer, 1999; van Osch et al., 2010). Observations reporting associations between plan specificity, with behaviour change and health outcomes are mixed, with some suggesting more specific action-plans are associated with positive changes in target health behaviours and health outcomes (Frie et al., 2020; van Osch et al., 2010; Ziegelmann et al., 2006), but others reporting that action-plan specificity is unrelated to fruit and vegetable consumption (Domke et al., 2019; Jackson et al., 2005), physical activity (Fleig et al., 2017; Kelly, 2017) and weight loss outcomes (Dombrowski et al., 2016). There is growing interest in how specificity of plans is measured and defined within interventions. Prior attempts to measure the specificity of action-plans have relied on the use of descriptive categories such as 'non-specific', 'medium-specific' and 'highly-specific'. These measures stem from researcher-based coding of data gathered from intervention material (Keller et al., 2017; MacGregor et al., 2006; Reinwand et al., 2016; van Osch et al., 2010). However, it is also possible to count the presence/absence of specificity related components, such as ‘what’, ‘where’, ‘when’, and/or ‘who with’, within individual action-plans, and produce a summary numeric score based on these components (Dombrowski et al., 2016; Mistry et al., 2015; Wiedemann et al., 2012). Some studies have also added a ‘how’ component (Ziegelmann et al., 2006). Here we operationally define specificity by counting the number of ‘what’, ‘where’, ‘when’ and ‘who with’ components in line with Dombrowski et al.’s methodology (Dombrowski et al., 2016). A study of 619 action-plans from 229 participants which reports on individual specificity components, found that individuals who noted *less* specific responses (i.e. what to do) or who were *more* specific in detailing ‘when’ to act on their physical activity plans were *more* likely to enact those plans (Fleig et al., 2017). However, others report that action-plans with highly specific time cues (‘when’) were *less* likely to be enacted (Keller et al., 2017). Ziegelmann et al. observed that only around half of the average 2.18 (SD =0.84) action-plans set by 314 participants in their study were highly specific (including elements of ‘what’, ‘when’, ‘where’ and ‘how’). This suggests that, even if participants set a high number of action-plans, many may be of poor quality. Reinwand et al. categorised participants’ (n = 346) action plans as low, moderate or highly specific, and reported similar observations to Ziegelmann et al., with just over half of plans (69.9% of physical activity and 59.7% of fruit and vegetable plans) being categorised as highly specific (Reinwand et al., 2016). Fleig et al. also reported that specificity of action-planning declined over time (Fleig et al., 2017). These observations may be important as it has been proposed by some, that the specificity, or quality, of action-plans is more important than the quantity set (de Vet et al., 2011).

In summary, the obesity epidemic is driving the increased prevalence of type 2 diabetes (Wilding, 2014) and in order to induce lasting weight loss, obesity interventions need to attempt to identify the mechanisms or predictors that can effectively modify lifestyle behaviours associated with weight loss. Despite emerging evidence that the self-regulation strategy of action-planning is an important element of behaviour change interventions, evidence exploring the relative contribution of quantity and specificity of action-plans to intervention effectiveness, informing the question of ‘what makes a good plan’, is sparse and the role of different action-planning characteristics are not fully understood (Michie et al., 2004). Furthermore, data from non-student populations is lacking (Jackson et al., 2005), so current evidence may be limited in its generalisability to real-world populations. Evidence suggests that older people lose more weight and engage better in weight loss interventions and attend more sessions (DeLuca et al., 2020; Finkler et al., 2012; Newman et al., 2001; Sauder et al., 2021) and that men lose more weight than women if they participate in weight loss trials (Chopra et al., 2021; Thom et al., 2021). These observations were supported by UK National Diabetes Prevention programme findings (Sauder et al., 2021). Investigating the components of multiple action-plans set across the course of an intervention may be important for behaviour change, as it enables action planning to be researched as a dynamic rather than static activity and can aid understanding of how engagement in this process can vary over time. A clearer pattern of how individuals engage in action planning over time would have implications for subsequent behaviour change research, and providers and practitioners when developing effective and targeted planning interventions. This study builds on previously published research, but is the first that we know of, to investigate action-plan content, quantity *and* specificity over time, and do so, in a sample of overweight and obese adults, to examine any associations with weight loss The aims of this exploratory study are therefore to (a) describe in detail the quantity, content, and specificity of multiple action-plans that people made over time, in a large-scale lifestyle (diet and physical activity) intervention (The Norfolk Diabetes Prevention Study; NDPS), and (b) investigate whether the quantity and specificity of action-plans were associated with greater initial weight change (from baseline to 4 months).

Context for research

The Norfolk Diabetes Prevention Study (NDPS) intervention provided an opportunity to examine the detailed content of action-plans and association between the quantity and quality of action-plans and weight loss in a real-world setting. NDPS was a seven-year programme (UK National Institute for Health Research NIHR RP PG 0109-10013) that identified people with prediabetes or a new diagnosis of Type 2 diabetes in the East of England. Eligible participants entered a randomised controlled, three-arm trial with up to 46 month follow-up, testing the effects of a group-based diet and physical activity lifestyle intervention, with or without the support of trained lay volunteers with Type 2 diabetes. The study protocol, details of the lay volunteer programme and main results of the prevention trial, showing a 42% reduction in 2-year risk of high risk groups developing type 2 diabetes, are published elsewhere (Garner et al., 2019; Pascale et al., 2017; Sampson, 2021).

Research questions

RQ1: How many action-plans were written over the six ‘core’ intervention sessions of the NDPS intervention, what was their content and how specific were they?

> *RQ2: How does the quantity, content and specificity of ‘action-plans’ vary according to participants’ baseline characteristics?*

RQ3: How are quantity and specificity associated with weight loss between baseline and the end of the six ‘core’ intervention sessions at four months?

Methods

Design

A prospective cohort design was used to examine associations between the specificity and quantity of action-plans and changes in weight at four months. The study was nested within a randomised controlled trial (RCT) of an intensive lifestyle intervention to support diabetes prevention and management; the NDPS as described above (Pascale et al., 2017; Sampson, 2021).

Participants

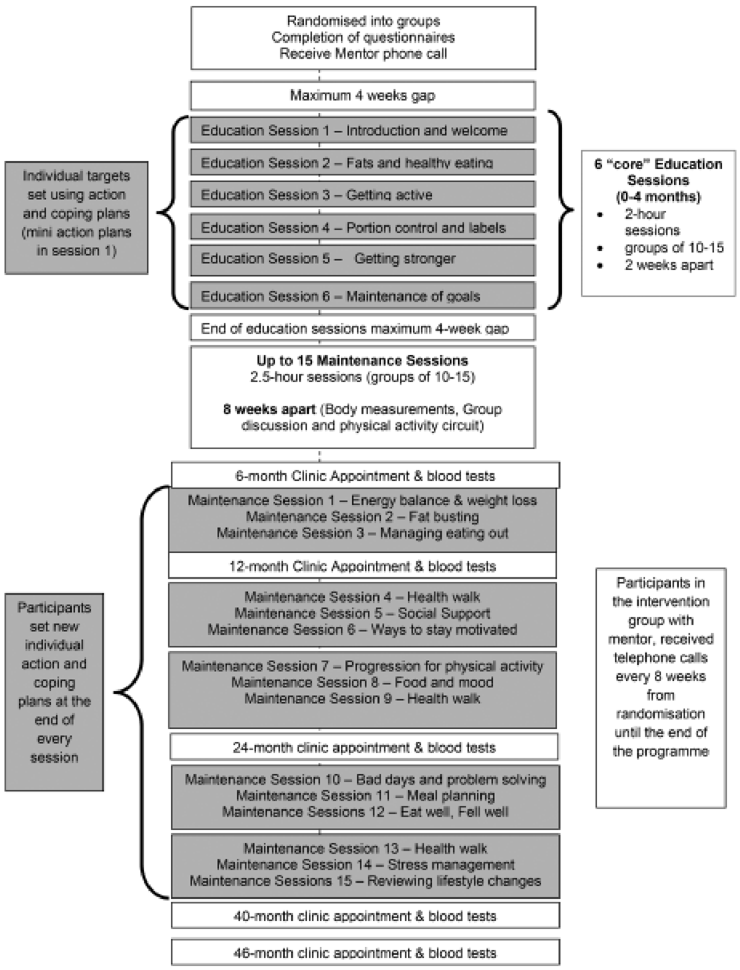
Males and females aged 40 years and over with either prediabetes or newly diagnosed type 2 diabetes who were randomised into either of the intervention arms of the NDPS.

Intervention

The NDPS was a randomised controlled 3-arm parallel group trial with up to 46 month follow-up that tested a group-delivered, theory-based lifestyle intervention that was delivered with or without the support of trained lay volunteers (diabetes prevention mentors [DPM]) with type 2 diabetes, and is described in detail elsewhere (Murray et al., 2011; Pascale et al., 2017; Sampson, 2021). Briefly, the intervention aimed to support long-term changes in physical activity and diet using patient-centred counselling techniques to encourage decision-making about behaviour changes; increase motivation to change; engage social support; aid individually tailored goal setting, action-planning, and self-monitoring; and support problem solving. Behaviour change targets were set by participants, who were encouraged to think about (and were presented with the health benefits of) a 7% weight loss if their BMI was >30 kg/m^2, achieving 150 minutes per week of moderate intensity physical activity over five days or more, 2–3 sessions of muscle-strengthening exercise per week, and reducing intake of total and saturated fat. The intervention sessions were delivered by trained professionals (diabetes prevention facilitators [DPF]) with backgrounds including dietetics, nutrition, physical activity and sports science; or delivered jointly by DPFs and DPMs. The intervention comprised six two-hour ‘core’ educational, bi-weekly, group sessions of varying content held within the first 12 weeks, followed by *up to* 15 maintenance sessions eight weeks apart from month four onwards. Maintenance sessions were discussion based and all followed the same format, including a 50-minute supervised physical activity/muscle strengthening exercise session. Maintenance sessions all began with a progress review section, followed by a healthy eating or physical activity topical discussion which differed at every session, then all sessions concluded with a planning section where participants noted their action and coping plans. See NDPS Intervention session flow diagram (Figure 1). The final section of each intervention session (‘core’ and maintenance) involved discussion on action-planning to motivate individuals to translate intentions around the behavioural targets into actual behaviour change. A hard copy of an ‘action-planning’ worksheet (printed on a single A4 page), was handed out and participants were asked to note their action-plans for the period of time until the next session. Participants were instructed to set action-plans relating to the focus of the intervention session. Participants could set an action-plan including new content or could repeat content that they had included in a previously written action-plan at any other of their intervention sessions if they felt they has not achieved their goal. Four types of ‘action-planning’ worksheets were used during the six ‘core’ intervention sessions;

a brief ‘mini action plan’ (Education Session 1), planning worksheets focussed specifically on healthy eating (Education Sessions 2 and 4) or physical activity (Education Sessions 3 and 5) and a combined action-planning worksheet where participants could choose to make dietary OR physical activity focused plans, OR both (Education session 6). Therefore, if the participant chose to complete a combined action plan in session 6, in total, participants were handed six planning worksheets over the course of the ‘core’ Education phase of the intervention. If the participant chose to complete *both* a healthy eating and a physical activity worksheet at the end of Intervention session 6 then a total of seven planning worksheets would have been provide to them over that part of intervention period. These plans completed during the ‘core’ sessions are the focus of our analyses here. When writing their action-plans, participants were told there was no maximum number of action-plans they could make and were asked to consider, and encouraged to use, ‘the 4 Ws’; WHAT, WHERE, WHEN AND WHO WITH to make their action-plans more specific. In both ‘core’ and Maintenance sessions, after setting their action plan, participants were also instructed to make plans using an ‘if-then’ structure outlined by implementation intention theory (Gollwitzer, 1999) as part of coping planning and problem solving, but these are not considered within this paper.

Figure 1. •••. AQ10



Data collection and sampling

A sequential sampling approach was used. All action-plans written within the six 'core' intervention sessions (first four months of the intervention) by participants in the first 25 intervention groups in either intervention arm of the NDPS trial were used for this research. Participant weight was measured at baseline and again after their 'core' intervention sessions (four months post-baseline assessment) using a Tanita BC-420sMA body composition analyser.

Measures

1. ***Baseline participant variables.***
    a. *Gender*—male OR female
    b. *Age*—in years AND categorised by adults (40–64)/older adults (65+ years)

c. *Diagnosis*—'pre-diabetes' OR 'type 2 diabetes'
d. *Ethnicity*—white versus non-white
e. *Index of Multiple Deprivation (IMD)*—ranking score (ranging from 1 = most deprived area to 32,844 = least deprived area) based on participant postcodes (Office_National_Statistics, 2015)
f. *Trial Arm*—lifestyle intervention arm of 6 'core' Education and up to 15 maintenance sessions (INT), OR the same intervention with additional support from diabetes prevention mentors, trained volunteers with existing Type 2 diabetes (INT-DPM).
g. Intention—Measured using 7 items; 4-items assessing diet (1 item assessing intention to adhere to eating more healthily and three assessing areas of healthy eating recommendations [fat, saturated fat and fruit and vegetable intake]) and 3-items assessing intention to be physically active (2 items from Sniehotta et al. (2006) and a further 1 item which extended the intention to do 30 minutes of moderate activity on 3 days of the week, to doing the same on 5 days of the week). All items were measured on a 5-point Likert response scale (Strongly disagree; Disagree; Neither agree nor disagree; Agree; Strongly agree). The responses to all 7 items were summed to produce a total intention score.

2. ***Planning worksheet and action-plan-level variables:*** Written action-plans were coded for quantity, content and specificity at the level of each worksheet and each individual action-plan
3. *Planning-worksheet type*—The four types of planning worksheets were healthy eating, physical activity, mini, and combined plans.
4. *Session Date and Number*—For each planning worksheet, the date on which and education session number (ranging from 1–6) in which it was completed were documented.
5. *Engagement*—For each individual planning worksheet, the section was coded as '0' if no action-plans were formed at all (i.e. a blank form) and '1' if any attempt had been made to write an individual action-plan (any attempt was noted as engagement).
6. *Quantity—Number of action-plans per planning worksheet*—The total number of action-plans an individual attempted to set on each planning sheet was recorded. All action-plans were included irrespective of length/content/focus (e.g. outcome and behaviour).
7. *Specificity—Presence of each component per action-plan*—The presence or absence of each What, Where, When, Who With element for each action-plan was recorded (1= used, 0= not used), so that pattern of use could be derived for each specificity element as well as allowing an 'overall specificity' score to be calculated (below).
8. *Specificity—Total score for each planning worksheet*—Each individually set action-plan was scored from 0–4 for specificity with one point given for each of the 'W' components

used. The sum of the specificity scores for all the action-plans set on each planning worksheet was calculated.

9. *Specificity—Average score for each action-plan listed on the planning worksheet*—Average specificity score per action-plan was calculated by dividing the total specificity score (as above) for each planning worksheet by the total number of action-plans on that worksheet.
10. *Content*—To generate a framework for coding the content of the action-plans, a purposive sample of 26 plans was selected and independently thematically coded by two researchers (NG and CG). Purposive sampling ensured the sample included both intervention arms and a range of Education session numbers (1–6), completion dates and types of planning sheet (n = 9 healthy eating, n = 17 physical activity). Thematic analysis (Joffe & Yardley, 2003) was used to organise the content of the action-plans into similar topics and categories. We used an inductive, 'content-driven' approach, deriving themes and codes from the data as opposed to codes being generated from pre-formed hypotheses. Following independent coding by each researcher, the themes and codes were compared and contrasted and a common coding framework was agreed through discussion between the two researchers. The resulting coding frame below was then applied to each individual action-plan.
11. ***Action Plan quantity and specificity variables—Per participant over the course of the intervention:***
12. *Quantity—Number of action-plans set over the course of the intervention*—The total number of action-plans set by each participant (across all planning-sheets completed in the first six 'core' intervention sessions) was calculated.
13. *Quantity—Average Number of action-plans made over the course of the intervention*—The average number of action-plans set per planning-sheet/session by each participant
14. *Specificity—Total score of all action-plans set over the course of the intervention*—The sum of the specificity scores for all action-plans completed over the six 'core' intervention sessions.

15. *Specificity—Average score per action-plan made over the course of the intervention*—For each individual, the total specificity score (as above) was divided by the number of action-plans formed during the six 'core' intervention sessions to provide a mean specificity score per action-plan over the intervention period.

Outcome variable

The primary endpoint was weight loss in kilograms (kg), measured by subtracting weight at baseline from weight at four month follow up.

Sample size considerations

Sample size calculations were conducted using G*Power 3 software package (Faul et al., 2007) for key elements of the planned analysis—(i) describing the content of action-plans and (ii) regression modelling of the associations between action-plan characteristics and individual outcomes. For the regression modelling, the sample size calculation was based on detecting a Cohen's *f*-squared (Cohen, 1988) of 0.15 or more. Cohen (1988) suggests that an *f*-squared value of 0.02 represents a small effect size, 0.15 a medium, and 0.35 a large effect. Cohen's *f*-squared equates to the proportion of variance in the dependent variable that is explained by a predictor variable (so a medium effect size of 0.15 equates to explaining 15% of the variance). To achieve 80% power with an anticipated effect size of 0.15, a significance level of 0.05 and the inclusion of all four participant level action plan predictor variables (as above), a minimum sample of 84 participants was required.

Data analysis

Raw data were extracted from the action-plans and entered in SPSS version 24.0. Data-checks and range checks were then completed. Descriptive statistics, including frequencies, percentages and standard deviations were used to summarise the quantity, content and specificity of action-plans. The relationships between action plan variables (quantity, content and specificity) and participant subgroups (intervention arm, baseline diagnosis, age, deprivation score, gender and intention) were explored using independent sample t-tests and correlation coefficients with p values. To address Research Question 3, first, univariate analyses were conducted for demographic and summary variables relating to quantity and specificity to establish which were significantly associated with the outcome variable (weight loss). Those that were found to be significantly associated with weight loss at a 0.05 level, were entered into a multivariate analyses (Tabachnick & Fidell, 2013).

Ethical considerations

Participants gave written consent to participate as part of the Norfolk Diabetes Prevention Study approved by the Essex Research Ethics Committee (Ref: 10/H0301/55) and Norfolk and Norwich Hospitals NHS Foundation Trust Research and Development department (Ref: 2010EC11/CSP 56696).

Results

A total of 890 planning worksheets completed by 106 participants yielded 1900 action-plans for descriptive analyses (RQ1&2). Four-month weight data were missing for seven (6.6%) participants, so 99 participants (93%) were included in the outcome analysis (RQ3).

Participant baseline characteristics

Participant mean age was 64 years (SD = 8.3), 61.3% (n = 65) were male, 96.0% were white British, 55.7% (n = 59) were diagnosed with pre-diabetes and 44.3% (n = 47) with Type 2 diabetes and 94.3% (n = 100) were either overweight or obese. This study sample was representative of the wider NDPS sample (mean age 66.3 years [SD = 9.2], 60.5% male, 94.8% White British), although there was a higher proportion (78.1%) with pre-diabetes in the NDPS sample.

RQ1: How many action-plans were written, what was their content and how specific were they?

Quantity of action-plans

From the 890 planning worksheets analysed, 883 (99.4%) worksheets included at least one written action-plan with 1900 individual action-plans set in total across all worksheets. The mean number of action-plans per worksheet was 2.12 (SD= 1.20; range 1–6), with a third of worksheets (n = 291, 32.7%) containing at least 3 or more action-plans. Just 1% of worksheets contained six action-plans, the highest number noted on any planning worksheet. As the number of action-plans per worksheet increased, the number of words used to form each subsequent action-plan decreased; with participants using a mean of 10.6 (SD = 7.1) words to form their first written action-plan on their worksheet, a mean of 8.21 (SD = 5.0) words for their second, 7.48 (SD = 4.1) words for their third and only 6.82 (SD = 3.71) words for their fourth ($t = 2.916$, df = 135, $p = 0.004$). Intervention session number (i.e. time in the intervention) was significantly negatively correlated with the quantity of action-plans per planning worksheet [$r = -0.137$, $p < 0.001$], meaning that as the intervention progressed, the number of action-plans set per planning worksheet decreased (Supplementary File 1). In total, over their six 'core' intervention sessions, participants set a mean of 11.44 (SD = 5.73, range 1–27) action-plans.

Action-plan content

Tables 1 and 2 show the types of physical activity and dietary changes planned by participants. The most commonly specified type of physical activity, present in 34.9% of plans was walking, with the second and third most common activities being cycling (9.5%) and swimming (8.8%). With regard to cardiovascular versus resistance exercise, 84.7% of all physical activity action-plans set included a cardiovascular activity and only 15.3% of action-plans included a resistance-based activity (Table 1). The content of all healthy eating plans was categorised according to EatWell Guide food groups. Over a quarter (26.1%) included 'high sugar/fat snacks' as a main focus; with 'fruit and vegetables' the second most commonly included item (22.1%) and 'meat/fish/alternatives' and 'carbohydrates' equal third most common (11.3% and 11.0% respectively). The behavioural focus in the majority of action-plans (37.0%) related to a 'decrease in dietary component', most commonly referring to high sugar/fat snacks. The second most common behavioural focus related to an 'increase in dietary component' (17.2%), most commonly referring to fruit and vegetables (Table 2).

Table 1. Physical activity related content of chosen 'activity type' and 'form of activity' per written action-plan, split by gender and baseline diagnosis.

			GENDER			Baseline diagnosis		
			Male (N, %)	Female (N, %)	ALL (N, %)	Prediabetes (N, %)	T2DM (N, %)	ALL (N, %)
Activity type	Applicable	Total	504	856	856	465	301	767
		Swimming	45 (8.9)	75 (8.8)	75 (8.8)	41 (8.8)	34 (11.3)	75 (9.7)
		Cycling	54 (10.7)	81 (9.5)	81 (9.5)	50 (10.8)	33 (11.0)	83 (10.8)
		Running	11 (2.2)	12 (1.4)	12 (1.4)	8 (1.7)	4 (1.3)	12 (1.6)
		Walking	166 (32.9)	299 (34.9)	299 (34.9)	185 (39.8)	113 (37.6)	298 (38.9)
		Gym	35 (6.9)	55 (6.4)	55 (6.4)	27 (5.8)	28 (9.3)	55 (7.2)
		Racket sport	7 (1.4)	7 (0.8)	7 (0.8)	5 (1.1)	2 (0.7)	7 (0.9)
		Team ball games	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
		Garden	13 (2.6)	16 (1.7)	16 (1.7)	3 (0.6)	13 (4.3)	16 (2.1)
		Yoga/Pilates/tai chi	2 (0.4)	11 (1.3)	11 (1.3)	9 (1.9)	2 (0.7)	11 (1.4)
		Dance/aerobic class	4 (0.8)	38 (4.4)	38 (4.4)	33 (7.1)	5 (1.7)	38 (4.4)
		Muscle strength	42 (8.3)	73 (8.5)	73 (8.5)	47 (10.1)	26 (8.6)	73 (9.9)
		Other	58 (11.5)	99 (11.6)	99 (11.6)	57 (12.3)	42 (14.0)	99 (12.9)
Form of activity	Applicable	Total	435	315	750	453	290	750
		Resistance activity	54 (12.4)	46 (14.6)	100 (13.3)	64 (14.1)	36 (12.4)	100 (13.3)

			GENDER			Baseline diagnosis		
			Male (N, %)	Female (N, %)	ALL (N, %)	Prediabetes (N, %)	T2DM (N, %)	ALL (N, %)
		Cardiovascular activity	375 (86.2)	260 (82.5)	635 (84.7)	382 (84.3)	251 (86.6)	635 (84.7)
		Combined	5 (1.1)	4 (1.3)	9 (1.2)	7 (1.5)	3 (1.0)	9 (1.2)

*From the 1900 action-plans included for analysis:

(A) 954 action-plans were not relevant/missing for this analysis on activity type and 90 (67 from males, 23 from females) action-plans were applicable but were unable to be coded due to vagueness of written plan and (B) 1150 action-plans were not relevant/missing for this analysis on resistance type.

**From the 1900 action-plans included for analysis: 1043 action-plans were not relevant/missing for this analysis on activity type and resistance type and 90 action-plans (53 from prediabetes participants, 37 from participants with T2DM) were applicable but were unable to be coded due to vagueness of written plan. (B) 1150 action-plans were not relevant/missing for this analysis on resistance type.

~~*From the 1900 action-plans included for analysis:~~

~~(A) 954 action-plans were not relevant/missing for this analysis on activity type and 90 (67 from males, 23 from females) action-plans were applicable but were unable to be coded due to vagueness of written plan and (B) 1150 action-plans were not relevant/missing for this analysis on resistance type.~~

~~**From the 1900 action-plans included for analysis; 1043 action-plans were not relevant/missing for this analysis on activity type and resistance type and 90 action-plans (53 from prediabetes participants, 37 from participants with T2DM) were applicable but were unable to be coded due to vagueness of written plan. (B) 1150 action-plans were not relevant/missing for this analysis on resistance type.~~ AQ8

Table 2. Healthy eating related content of chosen EatWell guide food and behavioural focus, split by gender and baseline diagnosis.

			GENDER			Baseline diagnosis		
			Male (N, %)	Female (N, %)	ALL (N, %)	Prediabetes (N, %)	T2DM (N, %)	ALL (N, %)
EatWell guide food grouping	Applicable	Total	269	175	<u>444</u>	291	153	<u>444</u>
		Carbohydrates	26 (9.7)	23 (13.1)	49 (11.0)	31 (10.7)	17 (11.1)	49 (11.0)
		Fruit & Veg	45 (16.7)	53 (30.3)	98 (22.1)	57 (19.6)	41 (26.8)	98 (22.1)
		Dairy	25 (9.3)	9 (5.1)	36 (8.1)	25 (8.6)	12 (7.8)	36 (8.1)

			GENDER			Baseline diagnosis		
			Male (N, %)	Female (N, %)	ALL (N, %)	Prediabetes (N, %)	T2DM (N, %)	ALL (N, %)
		Meat/fish and alternatives	27 (10.0)	23 (13.1)	50 (11.3)	32 (11.0)	17 (11.1)	50 (11.3)
		High fat/sugar snacks / drinks	81 (30.1)	35 (20.0)	116 (26.1)	85 (29.2)	38 (24.8)	116 (26.1)
		Multiple food groups mentioned	26 (9.7)	13 (7.4)	39 (8.8)	21 (7.2)	9 (5.9)	39 (8.8)
		Food mentioned not listed as an EatWell food group	37 (13.8)	19 (10.9)	56 (12.6)	36 (12.4)	19 (12.4)	56 (12.6)
Behavioural focus	Applicable	Total	453	268	721	449	272	721
		Increase in dietary component	59 (13.0)	65 (24.3)	124 (17.2)	72 (16.0)	52 (19.1)	124 (17.2)
		Decrease in dietary component	189 (41.7)	78 (29.1)	267 (37.0)	166 (37.0)	101 (37.1)	267 (37.0)
		Swap of a dietary component	41 (9.1)	42 (15.7)	83 (11.5)	64 (14.3)	19 (7.0)	83 (11.5)
		Environmental factors	6 (1.3)	6 (2.2)	12 (1.7)	7 (1.6)	5 (1.8)	12 (1.7)
		Planning factors	13 (2.9)	20 (7.5)	33 (4.6)	24 (5.3)	9 (3.3)	33 (4.6)
		Avoidance	69 (15.2)	28 (10.4)	97 (13.5)	74 (16.5)	23 (8.5)	97 (13.5)
		Self-monitoring	20 (4.4)	7 (2.6)	27 (3.7)	10 (2.2)	17 (6.3)	27 (3.7)
		Multiple behaviours	2 (0.4)	1 (0.4)	3 (0.4)	2 (0.4)	1 (0.4)	3 (0.4)
		Outcome focused	54 (11.9)	21 (7.8)	75 (10.4)	30 (6.7)	45 (16.5)	75 (10.4)

			GENDER			Baseline diagnosis		
			Male (N, %)	Female (N, %)	ALL (N, %)	Prediabetes (N, %)	T2DM (N, %)	ALL (N, %)
*From the 1900 action-plans included for analysis: (A) 942 action-plans were not relevant/missing for the analysis on Food Grouping and 514 action-plans (338 from males, 176 from females OR 293 from prediabetes participants, 221 from T2DM participants) action-plans were applicable but were unable to be coded due to the written plan not listing an EatWell food grouping. (B) 936 action-plans were not relevant/missing for the analysis on Behavioural Focus and 243 action-plans (161 from males, 82 from females; 152 from prediabetes participants, 91 from T2DM participants) action-plans were applicable but were unable to be coded due to vagueness of written plan.								

~~*From the 1900 action-plans included for analysis; (A) 942 action-plans were not relevant/missing for the analysis on Food Grouping and 514 action-plans (338 from males, 176 from females OR 293 from prediabetes participants, 221 from T2DM participant) action-plans were applicable but were unable to be coded due to the written plan not listing an EatWell food grouping. (B) 936 action-plans were not relevant/missing for the analysis on Behavioural Focus and 243 action-plans (161 from males, 82 from females; 152 from prediabetes participants, 91 from T2DM participants) action-plans were applicable but were unable to be coded due to vagueness of written plan~~. AQ9

Action-plan specificity

The most commonly used specificity component, across all types of planning worksheet was ‘WHAT’ (n = 1871, 98.5%), followed by ‘WHEN’ (n = 936, 49.3%), then ‘WHERE’ (n = 512, 27.0%) and ‘WHO WITH’ (n = 472, 24.9%). This pattern remained consistent, irrespective of the number of action-plans noted on the planning worksheet (Supplementary File 2). Participants were least likely to use the ‘WHO WITH’ component on physical activity focused action-plans, and ‘WHERE’ on healthy eating focused action-plans (Supplementary File 2). The mean specificity score per action-plan was 2.24 (SD = 0.68), meaning that participants on average used only 2 out of 4 possible specificity components per action-plan set. An increase in the quantity of action-plans per planning worksheet was significantly associated with a decrease in the average specificity score for the plans contained in the worksheet [$r = -0.215, p < 0.001$] (Supplementary File 3). This pattern was consistent when considered across the whole intervention, as the higher the quantity of action-plans set in total across the six ‘core’ intervention sessions, the lower the average specificity score for each action-plan set [$r = -0.247, p = 0.015$].

RQ2: How does the quantity, content and specificity of action-plans vary according to participants’ baseline characteristics (age, gender, intervention arm, baseline diagnosis, deprivation score)?

Action-plan quantity per planning worksheet

As age increased, the quantity of action-plans set per planning worksheet significantly decreased [$r = -0.108$, $p < 0.001$]. Participants from the least deprived areas set significantly fewer action-plans per worksheet than those from more deprived areas [$r = -0.076$, $p = 0.024$]. Significant differences were also observed for baseline diagnosis, with participants with prediabetes setting a slightly higher number of action-plans per worksheet (Mean Diff = .17, $t = 2.08$, df = 887, $p = .038$) and in particular, significantly more action-plans on physical activity focused planning worksheets (Mean Diff = 0.26, $t = 2.163$, df = 350, $p = 0.031$) than participants with Type 2 diabetes (Supplementary File 3). Participants in the INT + DPM arm of the trial set a significantly higher number of action-plans per worksheet when compared to INT participants (Mean Diff = 0.20, $t = -2.47$, df = 888, $p = 0.014$). No significant differences were observed by gender ($t = -.510$, df = 889, $p = 0.610$) or baseline intention ($t = -1.186$, df = 89, $p = 0.239$).

Action-plan content

Details of action-plan content relating to physical activity and healthy eating, broken down by gender and baseline diagnosis are listed in Tables 1 and 2. In physical activity plans, dance and aerobic style classes as well as yoga and Pilates activities were noted far more frequently by females. More individuals with type 2 diabetes planned to visit a gym, when compared to participants with prediabetes. In dietary plans, fruit and vegetables were most often targeted by females along with the behavioural action to ‘increase a dietary component’, whereas males tended to target high fat and sugar snacks along with the behavioural action to ‘decrease a dietary component’.

Action-plan specificity per planning worksheet

As age in years increased, average [$r = -0.069$, $p = 0.041$] and total [$r = -0.137$, $p < 0.001$] specificity scores per worksheet significantly decreased. For gender, no significant effect was observed for total specificity scores per worksheet ($p = 0.313$), but a significant effect was observed for average specificity scores, with females setting more specific action plans per worksheet (Mean Diff = 0.15, $t = -1.974$, df = 881, $p = 0.049$). There were significant differences in total specificity scores according to baseline diagnosis, with prediabetes participants’ total specificity scores per worksheet, significantly higher than those individuals with Type 2 diabetes (Supplementary File 3). Prediabetes participants had significantly higher total specificity scores across the intervention (Mean Diff = 5.62, $t = 2.129$, df = 95, $p = 0.036$), indicating that as well as using more specificity components per planning worksheet at each education session, they also used them more consistently over the course of the intervention. Prediabetes participants used significantly more specificity components both on healthy eating (Mean Diff = 0.63, $t = 2.482$, df = 346, $p = 0.014$) *and* physical activity (Mean Diff = 1.11, $t = 3.352$, df = 350, $p < 0.001$) worksheets (Supplementary File 3). Finally, being randomised to the trial arm Intervention + DPM was significantly associated with higher total (Mean Diff = 0.80, t = −4.247, df =

888, $p < 0.001$) *and* average specificity scores (Mean Diff = 0.15, $t = -2.042$, df = 881, $p = 0.041$). No significant associations were observed for deprivation on average [$r = 0.063$, $p = 0.062$] or total [$r = -0.023$, $p = 0.491$] specificity scores, nor for baseline intention on average [$r = -0.059$, $p = 0.581$] or total [$r = -0.186$, $p = 0.081$] specificity scores.

RQ3: How are quantity and specificity associated with weight loss between baseline and the end of the 'core' intervention (four months post-baseline)?

Available participant level data (n = 99) showed an average weight loss at 4 month follow up of 3.22 kilograms (SD = 2.77); which is similar to that for the overall NDPS intervention sample (n = 910) with a loss of 2.96 kg (SD = 3.26) at the same time point.

Baseline characteristics

Baseline diagnosis was a statistically significant predictor of weight loss, with Type 2 diabetes participants losing more weight (M = 3.92, SD = 2.83) compared to participants with prediabetes (M = 2.70, SD = 2.65). Deprivation rank, age, gender, intention and intervention arm were not statistically significant predictors of weight loss (Table 3).

Table 3. Univariate linear regression analyses of each independent variable on weight loss outcome at 4 month follow up.

	Weight loss	Unstandardised		Standardised		
Variables	*M (SD)*	*B* (95% *CI*)	*SE*	*β*	*t*	*p*
Age		.031	.035	.089	.550	.380
		(−3.23 to 5.70)				
Age		.776	.555	.141	1.398	.165
Adults	2.82 (2.49)	(−.326 to 1.88)				
Older Adults (65+)	3.60 (3.02)					
Gender		−.735	.575	−.129	−1.279	.204
Male	3.49 (2.94)	(−1.88 to .406)				
Female	2.75 (2.44)					
Baseline diagnosis		1.23	.555	.219	2.21	**.030**
Prediabetes	2.70 (2.65)	(.124 to 2.33)				
T2DM	3.92 (2.83)					

	Weight loss	Unstandardised		Standardised		
Variables	*M (SD)*	*B* (95% *CI*)	*SE*	*β*	*t*	*p*
Intervention arm		.654	.557	.119	1.18	.243
INT	2.88 (2.53)	(−.450 to 1.76)				
INT + DPM	3.53 (2.98)					
Intention		.086	.088	.104	.978	.331
		(−.089 to .261)				
Deprivation rank score		< −*.001*	*.000*	−.159	−1.58	.117
Action-plan quantity[a]		.130	.047	.268	2.743	**.007**
		(.036 to .224)				
Action plan average specificity[a]		−.702	.417	−.170	−1.684	.096
		(−1.68 to .096)				
Action plan total specificity[a]		.041	.022	.189	1.880	.063
		(1.88 to .063)				

[a]Quantity of action-plan scores across the six ‘core’ Education sessions as a whole.

Quantity and average specificity of action-plans

In univariate correlations (Table 3), the quantity of action-plans made across the intervention as a whole, was significantly positively associated (R^2 = 0.076, p = 0.007) with weight loss at 4 month follow up. To illustrate the strength of the association, we split the sample into equal tertiles with the grouping cut points of 0–9 action plans (M = 2.54, SD = 2.8, 95%CI 1.549 to 3.532), 10–13 action plans (M = 2.93, SD = 2.4, 95%CI 2.052 to 3.806) and 14+ action plans (M = 4.04, SD = 3.0, 95%CI 3.034 to 5.038). Based on the number of plans made, participants who made 14+ plans lost approximately ~1.5 kg more weight than those participants who made less than nine. The average number of specificity components used in each action-plan (average specificity) was not significantly associated with weight loss at our prespecified 0.05 level (R^2 = 0.029, p = 0.096). As total specificity is confounded by quantity (number of plans) this was excluded from analysis exploring associations with weight loss.

A multiple linear regression analysis was conducted to assess the potential impact of baseline diagnosis and quantity of action-plans on weight loss. The overall model significantly predicted weight loss (F(2, 96) = 7.507, p = 0.001), explaining 13.5% of the variance (R^2 = 0.135. Over and above baseline diagnosis (R^2 = 0.048), the quantity of action-plans independently added to the prediction of weight loss at 4 months (Table 4), with every additional action-plan set across the course of the intervention, equating to a 0.14 kg increase in weight loss.

Table 4. Multivariate linear regression analyses on weight loss outcome at 4 month follow up (n = 99).

	Unstandardised		Standardised		
Variables	*B* (95% *CI*)	*SE*	*B*	*t*	*p*
(Constant)	−.451	1.01		−.448	.655
	(−2.45 to 1.55)				
Baseline diagnosis	1.42	.536	.253	2.65	**.009**
	(.356 to 2.48)				
Action-plan quantity[a]	.144	.046	.298	3.16	**.002**
	(.052 to .236)				

[a]Quantity of action-plan scores across the six 'core' Education sessions as a whole.

Discussion

The present study is one of a limited number to assess the quantity, content and specificity of action-plans set during the course of a lifestyle (diet and physical activity) intervention and report on observed changes over time. We found that, participants who set a higher number of action-plans achieved greater weight loss, with every additional action-plan set across the course of the intervention, equating to a 0.14 kg increase in weight loss. Participants used, on average 2.2 out of 4 possible specificity components per action-plan set and we observed a relationship between the two components with increases in quantity significantly correlating with decreases in average specificity scores. However, specificity of action plans was not significantly independently associated with weight loss. The most common subject of physical activity plans was walking and the most common behavioural targets for dietary change were decreasing unhealthy snacks (most commonly noted by men) and increasing fruit and vegetables (most commonly noted by women).

Our findings are in line with previous research relating successful behaviour change to the quantity of action-plans set (Lorig et al., 2014; Mistry et al., 2015; Wiedemann et al., 2011, 2012). Fortunately, this study did not experience intervention protocol adherence challenges reported by others (Michie et al., 2004; Skår et al., 2011; Wiedemann et al., 2012), as 99.2% of planning worksheets contained at least one written action-plan. Fleig et al. analysed content from 338 participant physical activity action-plans completed as part of a planning intervention compared to a control, and reported a mean of 2.69 (SD = 0.55) action-plans being set (Fleig et al., 2017). Researchers have queried how many plans participants form when no limitations on the number of plans is imposed (de Vet et al., 2011). The present study posed no limits on the number of action-plans an individual could form and observed a similar quantity to Fleig et al., with a mean of 2.12 (SD =1.20; range 1–6) action-plans set per planning worksheet. Our findings also concur with Fleig et al.'s additional observations that the quantity of action-planning declined over time, as we report that as the intervention continued, the number of action-plans written per planning-sheet, decreased at each subsequent session.

Our findings are in line with previous research which did not support a clear positive association between specificity of plans and successful behaviour change (Dombrowski et al., 2016; Domke et al., 2019; Fleig et al., 2017; Jackson et al., 2005; Kelly, 2017). Our observations actually suggest that higher specificity was associated with lower weight loss. When exploring quantity of plans, Webb (2006) proposed that forming multiple plans may be counterproductive due to the higher cognitive load at the planning stage, and we propose this too may be applicable for to specificity. Dombrowski et al. (2016) suggest that the effectiveness of forming specific plans may depend on the behaviour selected for change, as for dietary plans more detailed plans were related to greater weight loss, but this was not the case for physical activity plans. Fleig et al. reports that individuals who were *more* specific in detailing 'when' to act on their plans, were *more* likely to enact those plans (Fleig et al., 2017), whereas Keller et al. reports that action-plans with highly specific 'when' cues were *less* likely to be enacted (Keller et al., 2017). Our results show that the 'when' component of planning was used more frequently than the 'where' and 'who with' components, illustrating, in this study, participants repeated choice to use this component when setting action plans. Due to the repeated use over time and across multiple plans of the 'when' component within our study, we suggest further exploration of associations between the use of different specificity components and their effects on weight loss as reported by Fleig et al. and Keller et al. Similarly to Fleig et al., this study found that the specificity of action planning decreased over time (Fleig et al., 2017).

Planning interventions may be more effective if participants are trained on how to form specific action-plans (de Vet et al., 2011) as self-generated plans are generally less specific and therefore may be less effective, than plans formed when guided by an experimenter (Armitage, 2009; Ziegelmann et al., 2006). NDPS facilitators guided and supported participants to generate their plans, yet, no significant association between specificity and outcomes was observed. It may be that the more preconditions an action-plan requires, the more difficulty individuals experience in meeting these conditions and therefore the less likely the plan will be fully performed (van Osch et al., 2010). van Osch et al. (2010) further suggests that making a plan *too* specific, makes it more difficult for a participant to relate to, therefore making the specific plan distal to the individual and less likely to be recognised as an actual situation that they may encounter.

The present study suggests further exploration is required to explain the lack of effectiveness of specific plans. Further research could explore two levels of specificity that are of interest. The first is how many specificity components were included within each written action plan (what, where, when, who with) as was examined here, and the second, is how specifically each of those individual specificity components are articulated (for example, from least specific to highly specific, 1) jogging in the city, 2) jogging in a nearby park, 3) jogging in Central Park). Keller et al.'s action plans used an if-then structure and they coded specificity elements within the participants plans in this way; using presence of a planned routine ('a regularly occurring action sequence'), planned cue (specificity of when, where), activity-related specificity ('then' behavioural response) or and activity-related intensity ('light, moderate, vigorous'). Findings showed that linking to routines (e.g. after work) was positively related to plan enactment, whereas highly specific when-cues (e.g. Friday at 6.30 p.m.) showed a negative relationship (Keller et al., 2017). Therefore, highlighting the influence of specificity on outcomes may differ depending on how it is defined and measured. We propose that to fully address the effect of specificity on weight loss outcomes, alternative operational definitions and measurements of specificity should be explored. However, defining the specificity of each component in a way that allows for objective measurement is unlikely to be straightforward.

Strengths and limitations

The current research recruited a clinical population in 'real-life' community settings and was therefore not subject to limitations of previous studies which used easily accessible student samples (Jackson et al., 2005) or tightly controlled experimental conditions in which action-plans were generated (Skår et al., 2011; Wiedemann et al., 2012). The research participants were also representative of the targeted population and had a wide range of demographic characteristics (with the exception of ethnicity). Many studies (Araújo-Soares et al., 2008; Conner et al., 2010) are limited due to assessing action-planning through self-reported measures, usually Likert scale responses. We suggest that the methods for measuring the quantity of action-plans and their specificity in this study, may be useful in providing a truer and more fine-grained indicator of action-plan usage, and have high external validity as they can be applied to any planning intervention.

This analysis is potentially subject to sampling bias as data were analysed from the first participants to be enrolled into the NDPS trial. Participants who consent to take part in research about healthy lifestyles are likely to be more motivated to change their lifestyle behaviour, which may translate into higher engagement in planning (Dombrowski et al., 2016). We also acknowledge that being informed of a chronic health diagnosis may alter or increase motivation to engage with the intervention. The data reported are associations, and quantity and specificity may be confounded by other factors. For example, both action-planning and weight loss might be associated with motivation, and this could underlie the associations reported. Hence, no causal claims can be made and further research is needed to identify the most effective components of action-planning for optimising changes in diet and physical activity and any consequent weight loss. Although our data are derived from 1900 individual action-plans, the number of participants entered into the multivariate analysis was only 99. We may, therefore, have lacked power to detect smaller associations (e.g. between planning specificity and weight loss). Although in this study no significant association between specificity and weight loss was observed, caution needs to be applied as the associations were significant at a 0.10 level. Similar studies with increased participant numbers are therefore recommended to confirm the finding that specificity of action-plans is not independently associated with weight loss. The sample comes from a largely older, predominately white population, and results may not be translatable to more ethnically diverse populations, countries or to younger people. Finally, the follow up period is relatively short and so the duration of associations between action-planning and longer-term lifestyle change remain to be determined.

Further research

Further research is needed to examine the relationships between action-plan content and outcomes, particularly investigating the strength of associations between matching the action-plan focus to a directly relatable outcome behaviour i.e. physical activity, rather than a more distal outcome such as weight loss. It is also important to investigate the duration of any effects of action-planning on behaviour change. There is a need to investigate the similarity of multiple plans set over time. Despite a plethora of wisdom about the need for action-plans to be specific and time-related our findings did not support this. However, we do report that specificity of plans decreases over time and this may be due to participants referring back (and therefore reinforcing) previously plans rather than rewriting in full every time. Therefore, an important research question may investigate if participants tend to repeat the same planning goals or tend to generate a range of differently focused goals over time. In this study, when forming an action-plan, participants did not choose from a predetermined list of options. They were permitted to author the content of their plans themselves, therefore investigation of the relative value of open-ended, free text plans such as the ones used in this study, compared with pre-specified planning worksheets would be warranted. Evidence also suggests that benefits of planning may accrue over time (Sheeran & Orbell, 1999) and that beneficial effects are found in the long- but not short-term (Sullivan & Rothman, 2008), therefore, extended exploration in this cohort may be worthwhile. Hagger and Luszczynska (Hagger & Luszczynska, 2014) propose that priority areas for future research include the identification of mediators and moderators of planning intervention effects and establishing the causal role of action planning. Further research in larger data sets should use more sophisticated mediation analyses to identify how planning affects weight loss outcomes. Finally, undertaking similar analyses of action plans used in other types of interventions would be valuable.

Implications for practice

The results of this study tentatively suggest that quantity of action-plans, as opposed to quality, may be key for achieving successful weight loss. This study contributes to the planning literature by a) outlining how individuals chose to use specificity components within their plans (what, where, when, who with) and b) offering insight into the most frequently targeted content of healthy eating and physical activity plans. A challenge for intervention providers and healthcare staff involved in planning interventions would be to find ways to maximise the number of action-plans made by participants over the course of an intervention. The results have specific implications for the UK National Diabetes Prevention Programme (NDPP) (Sood et al., 2015; Valabhji et al., 2020), as evaluations of early delivery have reported that goal-setting elements are currently being delivered less than intended within the programme, with providers only delivering goal-setting in 52.5% of sessions (Hawkes et al., 2021). The NDPP should consider encouraging participants to freely set as many action-plans as they wish and on the most effective way to enhance delivery of the action-planning element of their programme to individuals at-risk of type 2 diabetes.

Conclusion

The present research provides an in-depth understanding of the nature, quantity and specificity of action-plans set by participants, using a framework of objective measures to describe the action-planning characteristics in a 'real-world' community based lifestyle intervention. Quantity, but not specificity of action-planning was significantly and independently associated with weight loss. Maximising the quantity of action-plans set may assist in achieving weight loss, although further research is needed to establish the causal role of action-planning in this and other contexts.

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Disclosure statement

The authors declare no competing interests.

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Data availability statement

Data availability queries can be discussed with the corresponding author directly.

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