elearning approaches to prevent weight-gain in young adults: a randomised controlled study

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What is already known about this subject?

- Young adulthood is a period of rapid weight-gain, leading to obesity for many
- Effective obesity prevention, specifically for young adults, is not currently routinely available or provided

What does your study add?

- Two potentially transferable on-line programmes, based on different theoretical models, to prevent weight-gain overtly or covertly, were both associated with prevention of the usual weight-gain observed in young adults

Abstract (word count=200, word limit=200)

Objective: Preventing obesity among young-adults should be a preferred public health approach given the limited efficacy of treatment interventions. This study examined whether weight-gain can be prevented by on-line approaches using two different behavioural models, one overtly directed at obesity and the other covertly.

Methods: A three-group-parallel randomised controlled intervention was conducted in 2012-2013 (trial registration number: UMIN000014529); 20,975 young-adults were allocated *a priori* to one control and two 'treatment' groups.

Two treatment groups were offered on-line courses over 19 weeks on 1) personal weight-control ('Not-The-Ice-Cream-Van', 'NTICV'), 2) political, environmental and social issues around food ('Goddess Demetra', 'GD'). Control-group received no-contact. The primary outcome was weight-change over 40-weeks.

Results: Within-group 40-week weight-changes were different between groups ($p<0.001$): Control (n=2,134): +2.0kg(95%CI 1.5, 2.3kg); NTICV (n=1,810): -1.0kg(95%CI -1.3, -0.5); and GD (n=2,057): -1.35kg(95%CI -1.4, - 0.7). Relative risks for weight-gain vs control: NTICV=0.13kg (95% CI=0.10, 0.15) $p<0.0001$; GD=0.07kg(95% CI=0.05, 0.10) $p<0.0001$.

Conclusion: Both interventions were associated with prevention of the weight-gain observed among control subjects. This low-cost intervention could be widely transferable as one tool against the obesity epidemic. Outside the RCT setting it could be enhanced using supporting advertising and social media.

Introduction

Obesity is a major public health concern but its treatment has been of limited efficacy[1]. Obesity prevention appears a preferable public health approach, but few reliable and effective, sustainable, solutions have been developed to date. Weight-gain, potentially leading to obesity, is most rapid in the transitional period spanning adolescence and young adulthood[2,3], and especially noted in those attending higher education[4,5,6]. Maintaining a healthy lifestyle throughout young adulthood has been shown to be an effective way of reducing the risk for chronic disease such as cardiovascular disease[7]. In theory, preventing this weight-gain should be relatively easy to achieve since the average weight-gain observed requires only an extra 50-100 kcal/day above estimated energy requirements. In reality, factors affecting human behaviour and weight equilibrium can vary extensively[8,9] and relapse into previous behaviours has been the rule[10]. The use of behavioural models for the prevention of weight-gain is under-researched.

US and UK public health policy encourages lifestyle changes to improve population health and outcomes by drawing attention to personal responsibility and empowerment[11,12]. Young-adults are establishing lifestyle habits independently, often for the first time[13]. Since young-adults are going to form future workforce and be the parents of the future, empowering them to resist unwanted weight-gain by establishing healthy lifestyles will lead to multiple benefits both at personal and societal level. However, young-adults are often resistant to advice and 'hard-to-reach' for health promotion. Young adulthood is a relatively overlooked lifecycle period for intervention, but concern about body weight is often high.

Advances in the technology and increased use of internet provide a low-cost platform for delivering and disseminating health messages. A new and evolving area in the promotion of lifestyle changes is elearning ie the use of interactive electronic media to facilitate teaching and learning. Given the high percentage of internet users, internet interventions are

underutilized. Over 80% of young people have smart-phones now, even in deprived communities, and 89.6% and 84.2% of the citizens have access to the Internet in the UK and US, respectively[14].

The present study examined the effectiveness of elearning approaches for preventing weight-gain and encouraging healthier lifestyles among young-adults in higher education based on two different behavioural models.

Methods

The trial was approved by the College of Medicine, Veterinary, and Life Sciences ethical committee and registered in the Clinical Trials Register of Japan, registration number: UMIN000014529). A separate study measuring and validating weights and heights in the same subject-base was approved by the NHS Glasgow and Clyde Ethics Committee.

Participants and setting

Eligible participants for this study were young-adults registered for undergraduate studies at a large multidisciplinary university, in a country with a very high prevalence of obesity, approaching 30% of all adults[15].

Design

A three-group parallel randomized controlled trial design was employed for the intervention, with an observational design for outcome data collection.

University email addresses and registration numbers were provided by registry to researchers, and used for *a priori* randomisation to 'treatment' or control groups, using statistical software (SPSS 19, Chicago). A table was created based on a unique 6-digit number for each of the 20,975 eligible participants. All were randomised, with 6,991 participants in group 1 (Treatment-1), 6,992 participants in group 2 (control group), and 6,992 participants in group 3 (Treatment-2), respectively (Figure 1). This large number ensured power to detect or exclude a small effect size and allowed for a potentially high non-response rate. In order to avoid inter-group contamination, and to retain a 'realistic' design, so that results might be directly applicable to other real-life settings, publicity about the interventions was avoided. Intervention groups were told that as part of university-wide services some new non-matriculated courses were being trialled for some students, and that participation was voluntary but not that allocation of the courses was random. There was no academic advantage to participation, and no disadvantage from declining. The act of following the link to the courses and subscribing to them implied consent. Participants had no obligation to continue logging in the courses or participate in any activities. This 'covert' approach was approved by the ethical committee as no potential harm to participants was identified. No financial or academic incentives were offered for participation, and there was no pressure to participate from 'reminder' invitations.

Weight-changes over the academic year (a 40-week period) in the population randomised to the RCT were collected through a questionnaire designed to explore lifestyle changes in young-adults. This was administered on-line to all students, separately and unconnected from the intervention, in order to reduce risk of biasing recruitment or responses for self-reported body-weight and height. An information sheet was incorporated into the questionnaire and completing the questionnaire implied consent to that study. Participants were free to withdraw from the study at any time and incomplete questionnaires were not stored. A commercial survey method was used to collect responses (SurveyMonkey, California, https://www.surveymonkey.com/mp/aboutus/).

Recognising the potential for bias in self-reported data, the self-reported weight and height data were validated against two different sets of measured data. One validation was conducted against data measured independently at the General Practitioner (GP) surgery located within the university campus. At the time of registration with the GP at the start of the academic year, all students are required to provide basic health information and have their weight and height measured by nursing staff using stadiometer and set of scales. The self-reported weights and heights from study participants were matched with their data collected from GP records and compared using statistical methods.

A second subsample of study participants was visited at their place of residence at the stat of the academic year. Their weights and heights were measured using Portable Stadiometer and a set of electronic scales (SECA), and those data were matched with their self-reported data.

Power Calculation and Masking

Sample size was estimated using data from a study[16] conducted in similar subjects, aged 20 (SD 3.6) which showed a mean 9-month weight-gain without intervention of 1.8kg, with SD 2.6. The power calculation (IBM-SPSS SamplePower) indicated that there would be 85% power to detect a difference in weight change of 1.8kg between intervention and control groups with a minimum of 290 evaluable participants in each group. Researchers were blinded to the group identity until after analysis.

Intervention

Materials, Delivery and Timings

Materials for the two intervention groups were developed based on the behavioural models described in the section below and tailored to the specific age group and time of the year

when the programmes were delivered (**Table 1**). A group of three people with expertise in nutrition and public health were involved in the content development of resources. A member of the team who also had expertise in web designing managed the learning platform (uploading the developed materials, storage and access) and further tailored the graphics for the materials. The time required to design and finalise the materials was about 140 hours per person spread over 20 weeks. Materials for the intervention were delivered in weekly instalments using the learning platform 'Moodle' which records each participant's 'log-in' times, dates and the on-line resources accessed and time spent on each. These data allowed an independent assessment of the use of the materials developed for the interventions. Emailing lists were created for each group, and every week an email was sent, informing participants of the topic for the week, with a password reminder for accessing the new materials that had been uploaded. Materials were posted weekly for 19 weeks with the exception of Christmas and Easter holidays, and remained accessible thereafter. Mailboxes were created for each group to allow communication between participants and feedback to the administrator if necessary.

Behavioural models

Use of an appropriate behavioural theory to design interventions is associated with larger effect sizes, according to a recent review and meta-analysis[17]. For the present study two contrasting simple theoretical models were used.

Treatment 1 'NOT THE ICE CREAM VAN' (NTICV). This treatment followed the 'rational model'[18], based on the assumption that people, when provided with information, will make the best choice for themselves with a view to maximising utility. While information exchange has been rather unsuccessful among obese subjects in weight-loss strategies[19], this rational model may fit better with weight-gain prevention. Thus the NTICV programme was directed towards non-obese people and addressed unwanted weight-gain and obesity overtly. The title referred to 'ice cream vans' (vendor trucks), which tour around neighbourhoods daily, as an obesogenic 'vector' which is very familiar to young-adults in UK:

this detail can be adapted to suit other cultural situations.

Treatment 2 'Goddess Demetra' (GD). This treatment was based on the 'stealth' model[20] directed at behaviours that are motivating in themselves, the desired outcome being a 'side-effect' of the intervention. This programme (named after the Greek goddess responsible for earth and sustainable food) aimed to prevent obesity covertly, by raising discussion around social and political movements which are associated with more, or less, healthful diets and lifestyles.

Statistical Analysis

Analyses were conducted using an intention-to-treat (ITT) approach to enhance methodological study quality[21] as recommended by the CONSORT group for improving the quality of reporting the results from parallel group randomised trials[22]. It aims to protect against threats to validity from attrition or incomplete responses[23] by analysing all data based on each participant's assigned group. For participants who did not provide follow-up data, the mean weight-change of responders in the group was assumed. Analyses of variance (ANOVAs) were conducted at baseline and follow-up to assess for any significant differences among the three groups (two interventions, one control). Independent t-tests were also conducted to test for differences between groups. Pearson correlation was used to examine the strength of relationships between self-reported and measured anthropometric data and Bland-Altman plots were used to assess the degree of agreement for the same.

Results

During the study, 1,412 'active participants' (23% of randomised subjects) logged-in at least once to the NTICV programme and 625 (11% of randomised subjects) to GD. Those subjects

randomised to intervention groups who subscribed to the groups and accessed the Moodle sites are defined as 'active' participants. Those who received the weekly emails but did not subscribe, and were not actively seeking to be removed from the mailing lists, are defined as 'non-active' participants. Twelve subjects asked to be removed from the NTICV mailing list, and three from GD.

Weight-changes

Baseline body-weight was provided by 5,903 participants and follow-up body-weight by 4,879 (follow-up rate 83%) (**Table 2**). Participants who provided follow-up data did not differ significantly from those who did not, by age, weight, height, or BMI. All weight-change data were found to be approximately normally distributed, using the Smirnov-Kolmogorov test.

Mean overall weight-change over the 40-week study-period for all participants (n=5,903) was -0.35 (95% CI -0.6, 0.3) kg. Mean overall weight-change within groups was: control group (n=2,134): +2.0kg (95%CI +1.5, +2.3); NTICV group (n=1,810): -1.0kg (95%CI -1.3, -0.5); and GD group (n=2,057): -1.4kg (95%CI -1.4, - 0.7) (**Table 3, Figure 2**). Weight-changes within groups remained significant (all p<0.001) when analysed separately for men and women.

Significant weight-loss was seen in both intervention groups for 'active' participants (those who logged in to the group at least once): NTICV (n=1,317) -1.2kg (95%CI -1.6, -0.6) p=0.001, and GD (n=592) -1.5kg (95%CI -1.7, -0.9) p=<0.001. The changes were statistically significant for both men and women when analysed separately. Among 'non-active' participants (who were receiving the weekly emails but never logged into the programmes), there were no significant weight-changes over the 40-week study period: NTICV (n=413): -0.1kg (95%CI -0.3, 0.2), p=0.743, GD (n=1,165): -0.2kg (95%CI -0.5, 0.4) p=0.675.

Odds ratios for weight-loss, compared to the control group, were; NTICV=27 (95% CI 21.7-33.6) p<0.0001, GD=43.8 (95% CI 31.0- 62.0) p<0.0001.

Relative risks for weight-gain, vs control, were: NTICV=0.13kg (95% CI=0.10, 0.15) p<0.0001; GD=0.07kg (95% CI=0.05, 0.10) p<0.0001.

Validation of weights and heights

Measured data were available for 1,448 participants (1,283 from GP data, 165 measured by principal researcher). Pearson correlations between these measures was very high, r=0.998, r=0.999 respectively, with a mean under-report of 0.5kg for weight.

Log-in activity and weight-changes

The use of the Moodle platform/week of both interventions fell by approximately 50% for the NTICV and by a third for the GD, during the intervention (**Figure 3**).

Rational Model-NTICV: Over the study period, 1,412 young-adults (mean age 18.4 SD3.1, 68% women) who subscribed as active participants made 10,470 log-ins to the home-page, with 5,410 viewings of weekly-materials. Of these, 305 participants logged in only once, 638 participants 2-5 times, 220 participants 6-10 times and 248 participants ≥11 times, up to an individual maximum of 106 log-ins. The average number of log-ins per active participant was 7.2 (SD4.1) up to an individual maximum of 106 log-ins. Mean log-in time per participant was 14.0(7.7) minutes. There was an inverse correlation (-0.217, p=0.01) between the number of log-ins and weight-change for the NTICV group.

Stealth Model-GD: 625 young-adults (mean age 21.4SD2.9, 48% women) subscribed to the group, making 5,863 log-ins with 1,233 viewings of weekly-materials. Of these, 169 participants logged in only once, 343 participants 2-5 times, 65 participants 6-10 times and 47participants ≥11, up to an individual maximum of 50 log-ins. The average number of log-ins per active participant were 5.4 (SD 3.4), with an individual maximum of 50. Mean log-in time/participant was 17.0(SD 9.1) minutes. There was no significant correlation between log-in frequency and weight-change for the GD group.

Analysed by weight-change category, both intervention groups showed fewer log-ins among weight-gainers, and more among weight-losers (p=0.034) (**Figure 4**). Analysed separately by gender, log-in frequency was higher among women losing weight, but not men.

Discussion

This study evaluated a web-based intervention to prevent weight-gain in young-adults. Two different behavioural models were examined, both of which were associated with avoidance of the increase in body weight usually seen among young-adults in the UK and US, with similar effect sizes. Without intervention, the weight-gain in the control group was similar to that observed in previous studies among young-adults in the UK[16,24]. A 'rational theory' intervention used a culture-specific model appropriate to young-adults in the UK, with the 'ice-cream van' as a familiar and eye-catching focus as a weight-gain vector, through which to deliver an overt individually-relevant weight-control programme. A second 'stealth model' aimed to generate interest in food production and marketing and related environmental and political issues, which contribute to overconsumption and weight-gain at a population level. Both interventions were associated with prevention of weight-gain for substantial proportions of young adult who engaged with the programmes, and could be adapted to be delivered using other culture-specific 'hooks' in other countries and for different population sectors.

Three previous studies[25,26,27] of programmes against weight-gain have been conducted in higher-education settings, all small. Hivert[25] et al randomised 115 students to control, or an intervention group which received seminars on obesity, weight, physical activity, diet, fortnightly for two months and then monthly until 24 months. The control group gained 0.7(SD 0.6)kg while the intervention group lost 0.7(SD 0.4)kg (p=0.04). The other studies were all negative. Gow[26] et al tested an online seminar on diet, delivered weekly in a 6-week 4-arm randomised trial. Those who received the seminar lost weight but only if combined

with self-weighing using scales provided in the gym. Dennis[27] et al assessed two on-line courses based on social cognitive theory, supplemented by face-to-face lessons delivered by an instructor. One of the groups received additional instructions on self-regulation. There was no control group. Thirty nine students who completed the 14-week study gained weight, with no difference between the courses. Other studies, such as that of Lytle et al have incorporated weight loss advice for overweight subjects[28], which sets them apart from our aim to focus entirely on weight-gain prevention in the whole population. A major weakness of all the existing studies was that participants were informed of the study aims, which is likely to have attracted more committed individuals, willing to report weight-change. As well as being much larger, our study was therefore unusual in its more 'realistic' design, randomising all eligible young-adults, and also in collecting weights and heights in a completely separate study, independently from the intervention programmes. We used self-reported data, as the only feasible method to collect information from a large free-living population, but validated them against weights and heights collected independently, openly in one sub-sample and in another covertly from routine measurements made at a health centre.

For most individuals, preventing weight-gain requires only small shifts in average energy intake or expenditure (50-100kcal/day), a great deal less than that needed for clinically important weight-loss, around 600kcal/day[29]. Our results suggest that engaging on-line with young-adults can help them make such a change in energy balance, sustainably to prevent weight-gain over an academic year. There was benefit not only for those who actively participated in the intervention groups and actually lost weight, but also among 'non-active' participants who merely received the weekly emails (without further engagement) as reminders or 'nudges' towards controlling energy intake/expenditure, and avoided weight-gain. It was not possible to study our subjects beyond 40 weeks, over the subsequent summer vacation. Interestingly, there is evidence that young-adults may gain less weight over the summer, but they do not lose the weight gained over the rest of the year[30].

None of the existing studies of on-line interventions have reported data on resource usage or links between resource use and weight-changes, from which to judge 'dose-effect' relationships. In our study activity fell approximately by a third in both interventions. This is in agreement with data from online studies aiming at weight loss[31]. Our study found that those who logged into both interventions the most times, lost less weight or had a greater tendency to gain weight. This may reflect greater concern among those with more marked weight problems, but could indicate links between screen-time and other behaviours, such as snacking or sleeping times. Further studies will be needed to define the best 'dose' for this type of intervention and for specific populations.

There were differences between the patterns of uptake of out two programmes. The 'rational' model, directed overtly towards preventing weight-gain, was more popular than the 'stealth' model (response rate 23% vs 11%), and most attractive to young women (68% of participants). The 'stealth' model, interestingly, was more popular among older male students (**supplementary Table 1**). A 'stealth' model of this type has only ever previously been reported in one very small study, with 104 student participants[32]. This quasi-experimental, non-RCT study examined two face-to-face courses, to which students were offered a choice, one focussed on obesity and health (more popular, with 79 participants), the other on health and society (29 participants). Those who chose the course on society and health had the greatest improvement in their eating habits, assessed by food-frequency, but subjects' weights were not recorded.

There are inevitably limitations inherent in research of this kind: several have already been discussed, and our results may not all able to be extrapolated to other settings, even after appropriate redesign of the models. The present study was conducted in only one centre, albeit large and broadly representative of similar higher education settings, and among an educated, but not elite, population sector. The intention-to-treat analysis used in this study may overestimate the effect size of the intervention and there are other more conservative methods that could have been used[33]. Reassuringly, though, even when our data was

analysed as per protocol, results remained significant. All studies of public health interventions have limitations in relation to predicted reach, impact and sustainability. This study was large in terms of the eligible participant-base, and targeted young-adults, a hard-to-reach and relatively under-researched, even neglected, group at a life-stage associated with rapid weight-gain[16]. Designing effective interventions specific to young-adults is challenging, with many competing elements aiming to attract their attention. Elearning has several advantages compared to traditional approaches, especially for young-adults, such as ease of tailoring to individual circumstances; translating complex information through video, graphics and audio systems; and cost savings on face-to-face interventions. It is unlikely that any single on-line programme would suit the needs and interests of all young-adults, and our two interventions appealed to different segments. Clearly there is interest both in weight-control and in the environmental issues around food among young people. Outside the confines of a randomised trial, there would be no reason to offer only one programme, and greater engagement could be encouraged with supporting local advertising and use of social media. A common theme from qualitative evaluation of the program was that students did not actively engage as did not pay attention to the email due to the volume of emails they receive. This is something to be addressed by supporting advertising if the intervention is introduced routinely outside the RCT setting.

Effective interventions to prevent weight-gain among young-adults, even with very modest effect sizes, would have massive public health value if they are sustainable and reach substantial sections of the at-risk population. The low cost and simplicity of on-line interventions makes sustainability more likely since access to the internet and social media is uniformed across all socio-economic status, in the young. Programmes should be adapted to the targeted population's needs, otherwise health inequalities will increase. University students used to represent a highly educated elite sector, but that is no longer the case in obesity prone European and North American countries: half of all young-adults now attend universities in the UK[34]. Inevitably, self-selection defines response rates and the characteristics of non-responders may be different. For NTICV, the response rate of 23% probably represents a substantial proportion of those who were currently fighting

overweight, or perceived that they were at risk of weight-gain. Similarly, it is possible that those who elected to participate actively with the GD 'stealth' intervention could also represent a section of young-adults with unusual attitudes or physical characteristics. It was important therefore to see that baseline weights and BMIs in the control group were very similar to those in the two intervention groups, and that the active and non-active participants had similar BMIs.

To conclude, two online interventions, based on 'rational' and 'stealth' behavioural models, both proved successful in preventing the expected weight-gain observed in young-adults. An online platform provides a simple and low-cost way to reach large segments of a targeted population for weight-gain prevention. The programmes developed could easily be replicated and adapted for a wider young adult population, and in other settings. Adding promotion through social media could enhance uptake and effectiveness when outside the RCT setting.

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Conflicts of interest

The authors declare no conflicts of interest.

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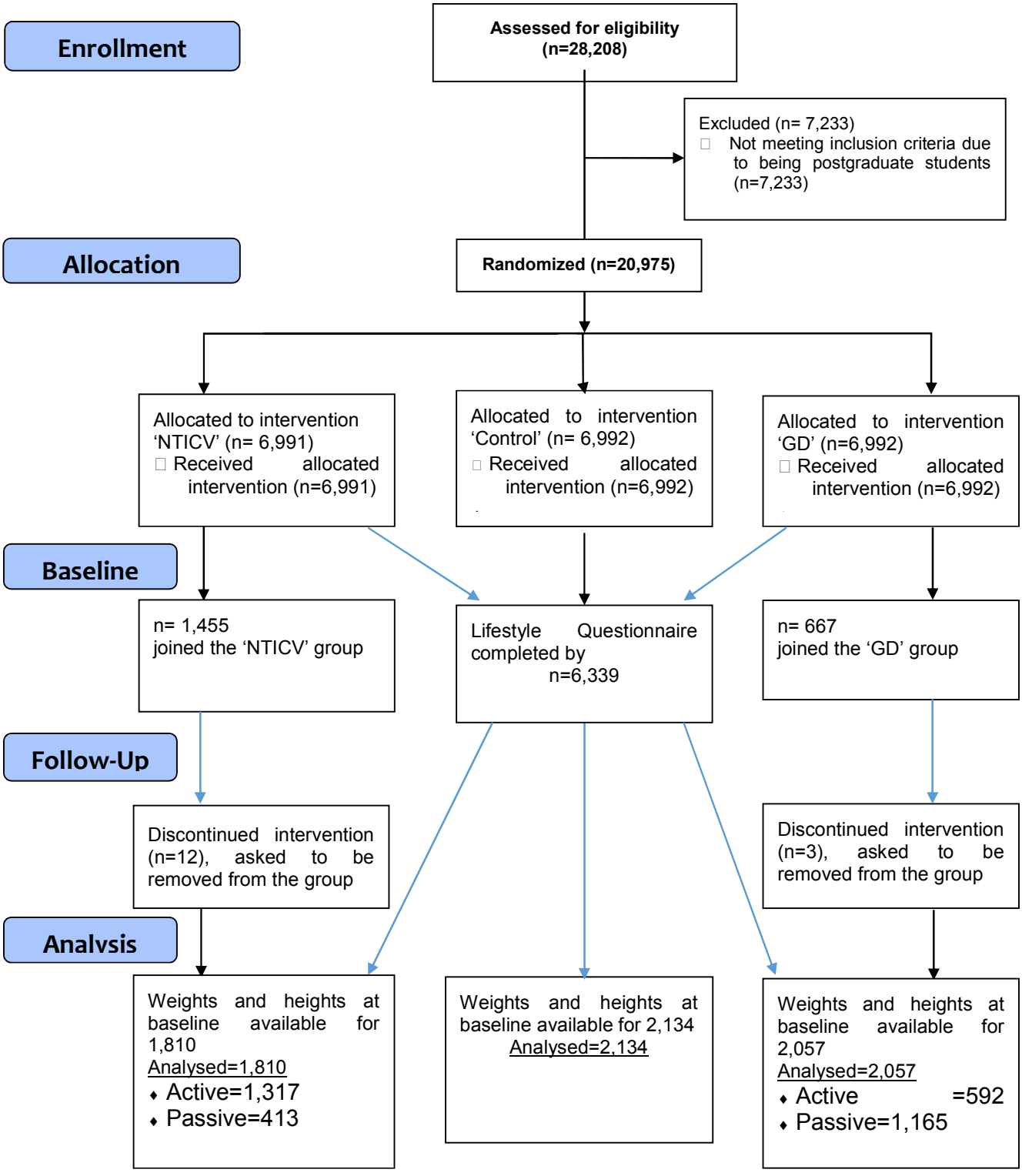
Figure 1: Study Flowchart



*NTICV=Not The Ice Cream Van, GD=Goddess Demeter

Figure 2: Weight-changes reported in a 9-month study period among participants in the; control group, Rationale Model-NTICV (overtly targeting weight control), and Stealth Model-GD (covertly targeting diet and lifestyles).

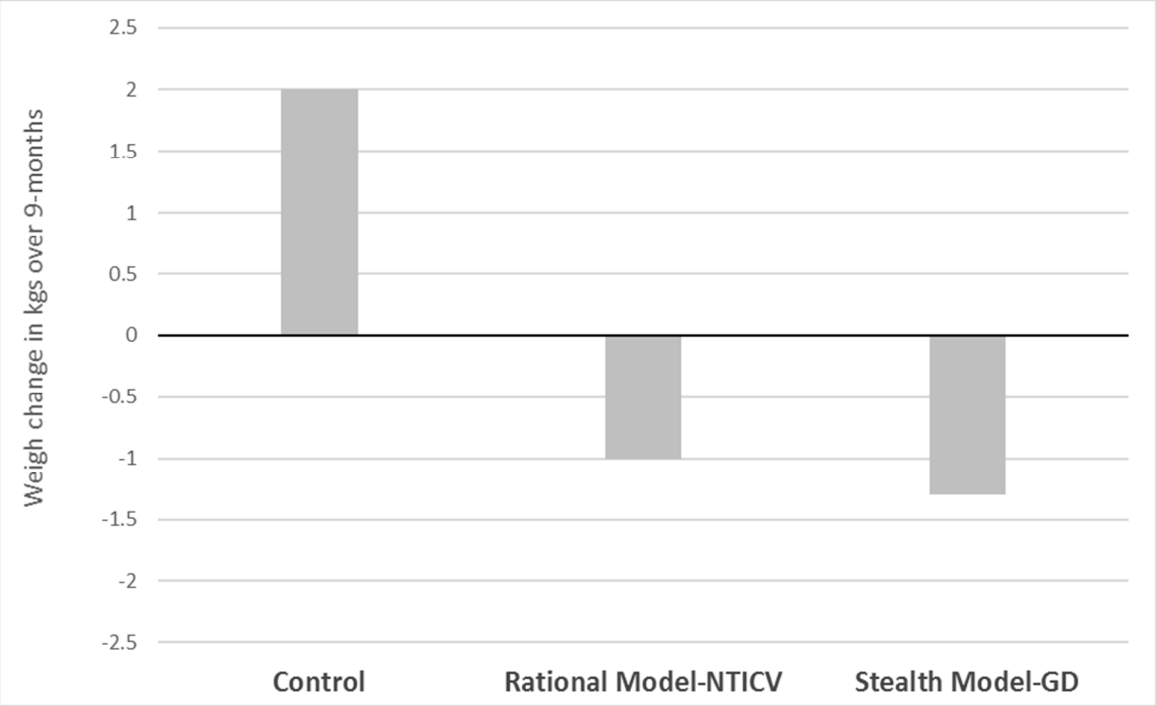


Figure 3: Weekly activity in logs for the duration of the study for the two interventions

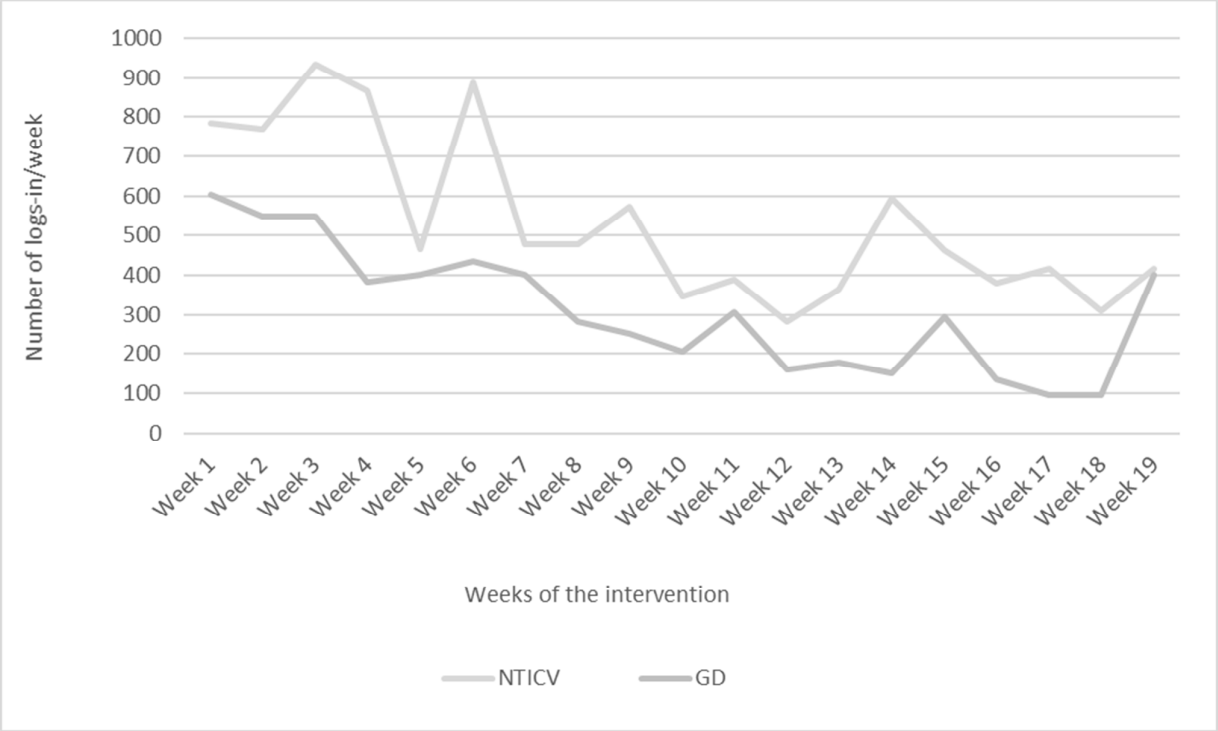
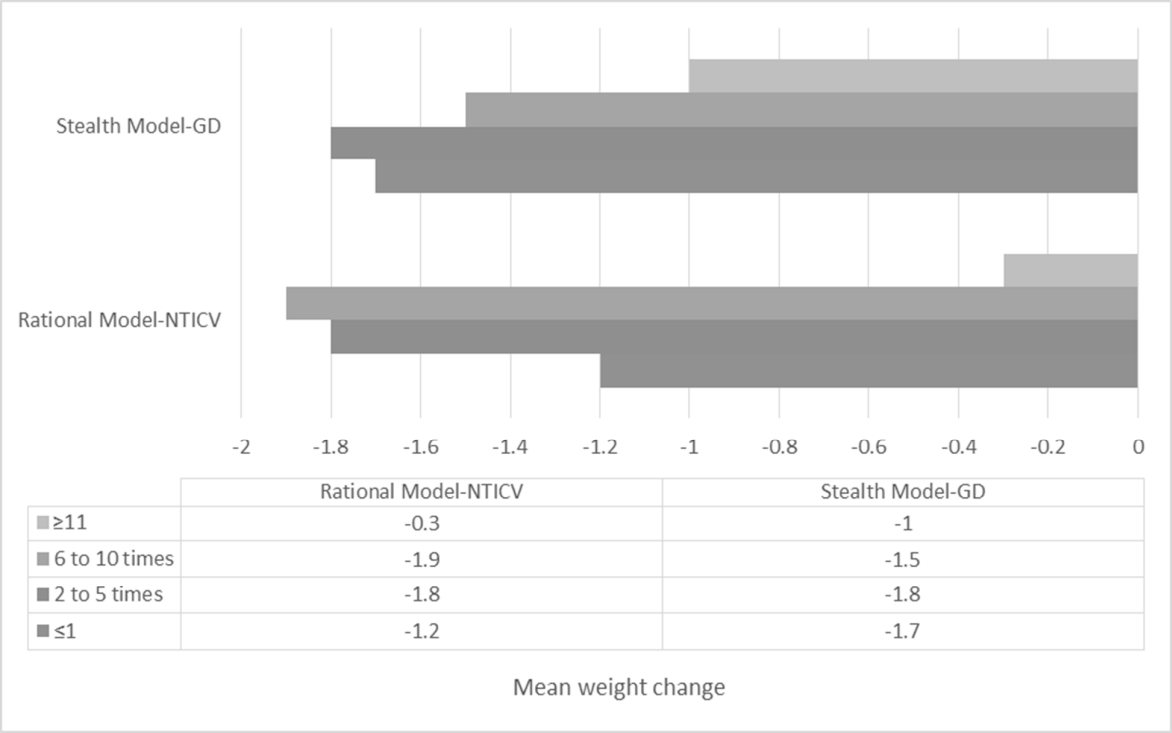


Figure 4: Logs in quartiles and mean weight change per quartile for the participants in the Rational Model-NTICV and the Stealth Model-GD.



	Rational Model-NTICV	Stealth Model-GD
≥11	-0.3	-1
6 to 10 times	-1.9	-1.5
2 to 5 times	-1.8	-1.8
≤1	-1.2	-1.7

Table 1: Weekly topics of the two interventions, NTICV (the group based on the rational model) and GD (the group based on the 'stealth' model)

Week	NTICV	GD
1	Weight, BMI, & waist circumference	Carbon footprint
2	Calories/energy & food myths	Cultivation
3	Calories/energy & alcohol	Sustainable Meat
4	Cupboard & cooking essentials	Sustainable Fish
5	Sugary & energy drinks	Food miles
6	Eating during exams	Fresh vs Frozen
7	Eating during Christmas	Christmas Marketing
8	New Year's Resolution	New Year's Resolutions
9	Snacking	Vending machines & snacks
10	Salt	Salt
11	Fat	Fat-Free products
12	Popular Diets	Marketing of diets
13	Ready Meals	Ready meals
14	Marketing	Supermarkets
15	Physical Activity	Food and Drink companies
16	Fast Food	Fast vs Slow food
17	Food Labels	Genetically modified products
18	Negative Calories	The power of marketing
19	Summary	Summary

Table 2: Participants characteristics, at baseline, by treatment group

Characteristic	All	Control	Treatment 1 NTICV (Rational Model)	Treatment 2 GD (Stealth Model)
n	5,903	2,134	1,810	2,057
Gender (% Female)	60	62	63	55
Age (years)	19.8 (3.1)	19.6 (3.2)	18.8 (3.1)	21.1 (3.0)
Weight (kg)	66.0 (13.4)	64.9 (12.6)	65.4 (13.1)	67.9 (14.6)
Height (m)	1.71 (0.1)	1.7 (0.1)	1.7(0.1)	1.72 (0.1)
BMI (kg/m^2)	22.3 (4.6)	22.2 (4.4)	22.3 (4.6)	22.6 (4.9)

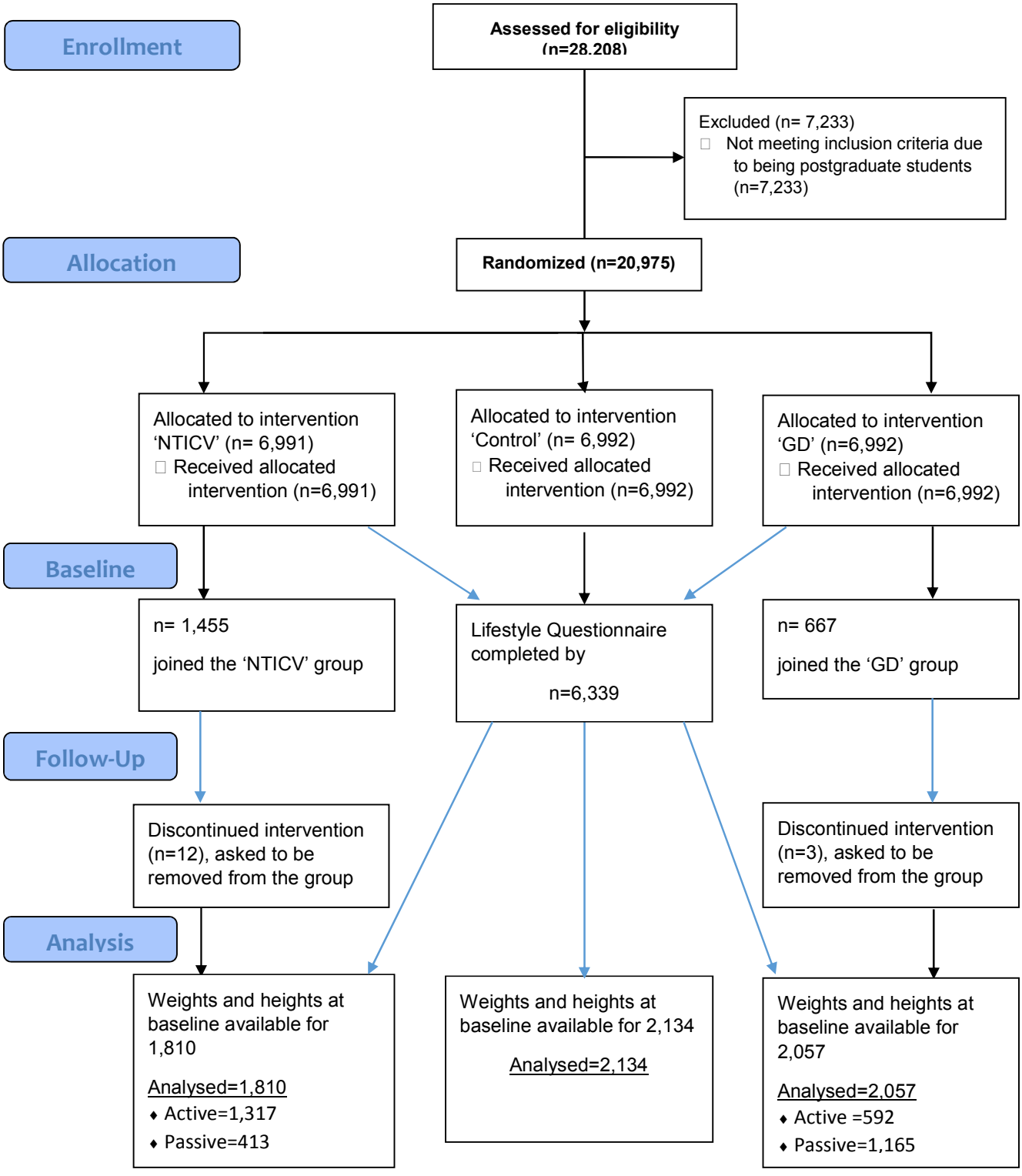
All data mean and standard deviation (SD)

Table 3: Participant characteristics at baseline and follow up, and weight-changes in the 9-month study period, by treatment group (Intention to treat analysis)

		Weight changes		
	Baseline	**Follow-up**	**Change**	**P value**
Weight				
Control	64.9 (12.6)	66.9 (13.2)	+2.0(1.1)	<0.001
Rational Model (NTICV)	65.4 (13.1)	64.4 (11.5)	-1.0(0.7)	0.001
Stealth Model (GD)	67.9 (14.6)	66.5 (14.2)	-1.3(0.4)	<0.001
BMI				
Control	22.2 (4.4)	22.5 (4.7)	+0.3(0.2)	<0.001
Rational Model (NTICV)	22.4 (4.6)	22.3 (4.1)	-0.1(0.1)	<0.001
Stealth Model (GD)	22.6 (4.9)	22.5 (4.8)	-0.1 (0.1)	0.02

*All data mean (SD)

Figure 1: Study Flowchart



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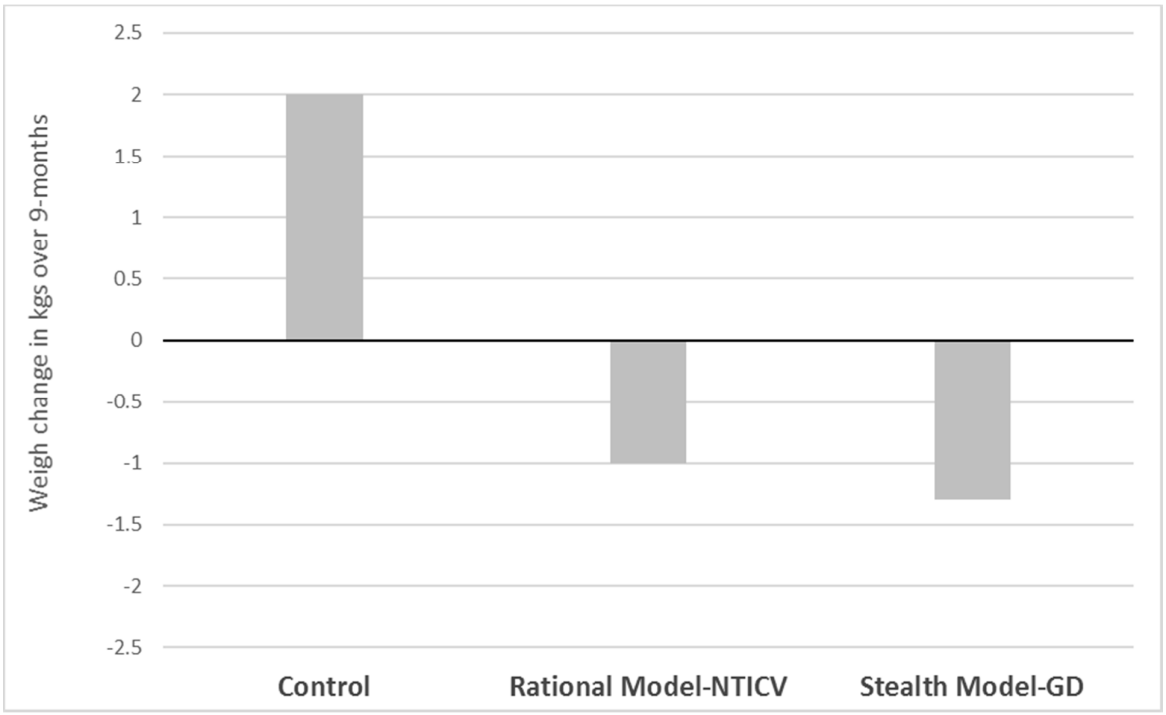

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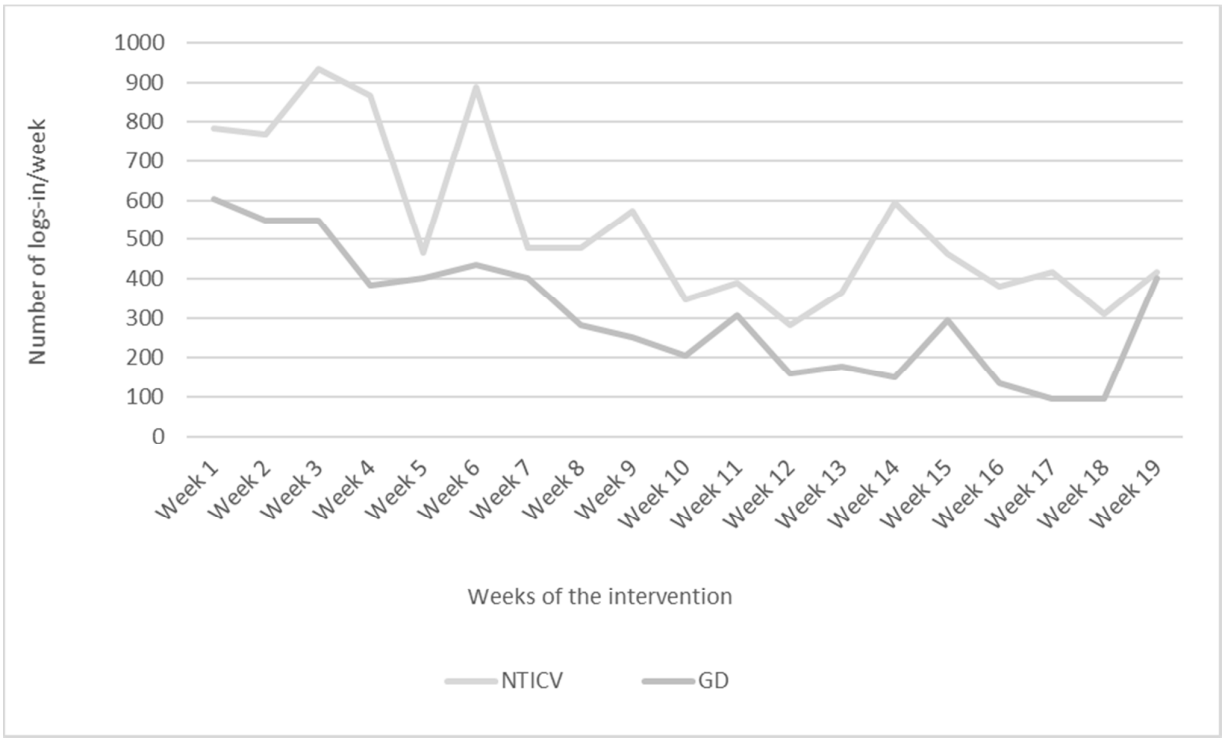

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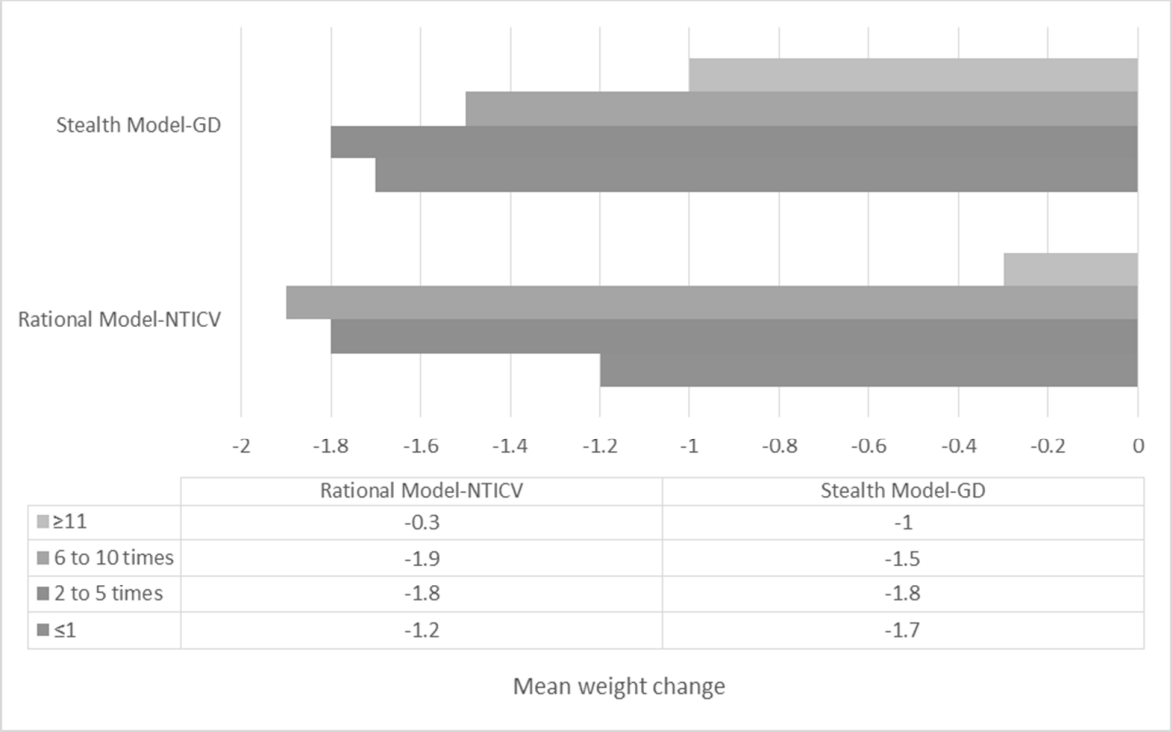

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2 to 5 times	-1.8	-1.8
≤1	-1.2	-1.7

Supplementary Table: 'Active' and 'Non-active' participants' characteristics, at baseline

Characteristic	Treatment 1 NTICV Active Group (Rational Model)	Treatment 2 GD Active Group (Stealth Model)	Treatment 1 NTICV Non-Active Group (Rational Model)	Treatment 2 GD Non-Active Group (Stealth Model)
n	1,317	592	413	1,165
Gender (% Female)	68***	52***	58	58
Age (years)	18.7*** (3.0)	22.3*** (2.5)	18.8 (3.2)	19.9 (3.5)
Weight (kg)	65.1*** (12.9)	69.2*** (13.8)	65.7 (13.3)	66.6 (15.4)
Height (m)	1.69**(0.1)	1.73** (0.1)	1.7 (0.1)	1.71 (0.1)
BMI (kg/m^2)	22.2** (4.2)	22.9** (5.2)	22.4 (4.6)	22.3 (4.6)

All data mean and standard deviation (SD)

x^2-tests were used for categorical variables and t-test for nominal variables

*p<0.05

**p<0.01

***p<0.001