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Do treats facilitate the interpretation of findings on caloric restriction?

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ABSTRACT

Introduction Food can build social bonds and enhance interpersonal relationships. An area of research perhaps at odds with food abundance, is caloric restriction (CR), intermittent fasting (IF) or short-term fasting (STF). We aimed to study the impact of offering treats on the audience during presentations on IF and STF and whether this impacted the audience's reception of the subject. The contradiction of the tempting nature of sharing brownies juxtaposed with the potential health benefits presented is a light-hearted subject in a world where nutritional intake and health outcomes are the object of intense academic discussion.

Objective Investigate how treats influence hospital personnel interpretation of information presented on the potential benefits of CR, IF and STF.

Methods This trial consists of a cross-sectional study (CSS) and a randomised controlled trial (RCT) conducted at three study centres. The CSS involved a survey administered to healthcare professionals to assess their knowledge, experience and willingness regarding IF and/or STF. In the RCT, brownies were randomly provided to healthcare staff attending a scientific meeting on restricting calories.

Results 135 participants were included in the CSS and 64 participants joined the randomised experiment. We found that the randomisation had no statistically significant effect. Only 2 out of 64 were aware of the irony of the provided treatment. In the CSS, participants most often cited the expected beneficial effects on their short-term and long-term health as important reasons for adhering to IF and/or STF. Perceiving fasting as beneficial was mostly influenced by knowledge on the topic and previously adhering to a fasting diet.

Discussion In this light-hearted, holiday-inspired exploratory study, we found that providing your audience with treats does not influence participants' opinion of you or your research, even when it focuses on the benefits of reducing calorie intake. The recipients of the treat will remain critical of presented findings, and due to prior experiences will be receptive to the counterintuitive topic of fasting.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Food enhances social bonds and facilitates development of interpersonal relationships. Food, or more specifically treats, can also motivate an audience to be receptive and engaged, facilitating transfer of information.

WHAT THIS STUDY ADDS

⇒ This exploratory study reveals that treating your audience with brownies does not influence their opinion and will stay critical of presented findings. Prior experiences are relevant to gauge your audience and tailor your presentation accordingly.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Although there is no clear evidence that treating healthcare workers increases their receptibility, it does result in a light-hearted social scientific adventure, spreading holiday cheer.

INTRODUCTION

Food has long been recognised to build social bonds and enhance interpersonal relationships, and research has shown that the act of sharing food can increase trust, cooperation and positive feelings toward others.[1–3] In the medical field, providing food to healthcare professionals has been used to boost morale and show appreciation for their dedication.[4 5] Among the confectionery delights known, one stands out: the brownie[6], recently published as an object of study. Whether it is the fudgy centre or the delicate crinkled crust, brownies have a way of evoking a sense of comfort and delight. The cocoa inside may be beneficial, as it was eaten in large quantities by the oldest human,[7] is associated with longer telomeres[8] and lowers the risk of cardiovascular disease and cancer.[9] Recently, intermittent fasting (IF) or short-term fasting (STF) have shown promising results in preclinical studies and is making its way into clinical research.[10–12] Fasting involves a temporary but stringent reduction of caloric intake which suppresses the insulin-like growth factor (IGF-1) and mammalian target of rapamycin (mTOR) nutrient response signalling pathways, boosting systemic resilience, stress resistance and defence mechanisms.[13–17] It has been linked to a range of health benefits such as

improved cardiovascular function, reduced inflammation and extended lifespan.[13–17] A growing body of research suggests potential health benefits when used as a preconditioning regimen in various medical procedures, for example, prior to surgery.[12 15 18–24]

Since evidence is emerging fast, its potential impact on medical practice makes it an appealing but rather counterintuitive topic for research and presentation, since it contradicts what is currently being taught during medical education. Making sure findings are considered, understood and correctly implemented plays a critical role in advancing medical practice.[25] Presenting research findings to professionals can be a challenging task, as it requires not only clear communication but also a receptive and engaged audience. In this context, food and the associated attitude and behaviour of professionals has been receiving attention,[26 27] as it can motivate professionals to attend a meeting, but also be more engaged.[28] Additionally, the audience's prior attitudes and beliefs about IF and or STF may affect their receptiveness and engagement with the presented findings. Providing brownies to healthcare staff during a research presentation on fasting may serve to increase their interest and engagement. Understanding prior experiences, knowledge and attitudes of individuals regarding fasting is of vital importance in tailoring the presentation to the audience. This could increase the receptiveness to adopt beneficial practices, for themselves or for the patients they provide care for.

The goal of this light-hearted, holiday-inspired article is to investigate whether the offering of treats, in this case brownies, to healthcare staff before a research presentation on IF and STF, can affect their interest and perception of the research findings. To answer this question reliably, we need to explore potential attendants' prior knowledge, experience and attitudes towards fasting, as this can influence the effect of the treat. We hypothesise that providing a treat positively influences the score given by participants who are not familiar with fasting, while not or negatively influencing the participants who are familiar with it. By combining two studies we hope to shed light on the factors that shape the attitudes of medical professionals toward research into fasting, to facilitate successful implementation of potential findings of current research,[29–31] and ultimately contribute to evidence-based strategies. In summary, our study explores the effect of treats offered as a treat during presentations about IF and STF, while accounting for the irony of the situation: a calorie-rich brownie versus the information on the potential health benefits of restricting calories.

METHODS

This study was designed as an umbrella trial,[32] consisting of a cross-sectional study (CSS) across all three associated study centres and a randomised controlled trial (RCT). The CSS focused on the knowledge and experience of healthcare workers with IF and/or STF and their willingness to put it into practice. This study was conducted as an exploratory respondent study and consisted of an online survey to a large sample of healthcare professionals. We selected all three study centres to get a complete overview and representative study population. The survey included questions on demographic characteristics (such as age, gender and occupation) and assessed their attitudes and beliefs toward fasting. In the RCT we randomly provided brownies to healthcare staff attending a scientific meeting, occurring at two of the three study centres. These two sites were chosen because they already provide regular scientific meetings with rotating presentations of PhD students, where the coordinating investigator was scheduled to present. The primary outcome was the difference in total score given to the presentation, as measured by a post-presentation survey. This survey consisted of separate scores for every aspect of the presentation (f.i. visual, scientific content and novel value), which were totalled for the total score. Secondary outcomes of interest were the difference in these subscores, self-reported changes in knowledge, attitude toward and prior experience with fasting and how the participants themselves thought the intervention affected their score. We aimed to include a sample size of 75 healthcare professionals for the RCT, and 150 for CSS. Due to the exploratory and practical nature of this study, and the fact that participation was completely voluntary, no sample size calculation was employed. Additionally, no prior data on effect size of this intervention is available.

Cross-sectional study

We selected 200 email addresses of healthcare professionals from departments associated with the active clinical trials.[29–31] The survey was sent twice, on 26 April 2023 and 10 May 2023, and people were given a response window of 6 weeks from 26 April 2023. The email stated that we were investigating the experience of healthcare workers with IF and STF. We explicitly stated that filling out these surveys was completely voluntary and that the provided answers would be analysed anonymously. The survey focused on the experience with (short-term and/or long-term and/or fasting) diets, both in general and before a medical intervention, but also asked people to self-rate their knowledge on the subject and to provide a summary of the beneficial effects in layman's terms. A team of experts on IF, STF and caloric restriction rated these summaries on a scale from 0 to 100, blinded to any other identifying factors. Finally, respondents were asked if they would adhere to a fasting diet, in general but also in the scope of a clinical trial, and the associated reasons for adherence or non-adherence were explored.

Randomised experiment

For the randomised experiment, participants were included during two separate research meetings in April 2023 in both the Princess Máxima Center for Pediatric Oncology (Utrecht, the Netherlands) and the Erasmus MC Transplant Institute (Rotterdam, the Netherlands).

These research meetings were open to all affiliated departments. Reminders for the meeting were sent out a week in advance, providing information about the topic but without disclosing the experiment in advance. All participants voluntarily joined the research meeting and were explicitly asked permission for the brownie-procedure and survey, prior to the start of the presentation. Contents and protocol on this investigational product have been published earlier.[6] At the start of the presentation, colleagues were informed about the content of the presentation; an update on the active clinical trials investigating STF.[29–31] After this brief introduction, they received information about the current randomised study. Participants were asked to fill in the baseline questionnaire using their mobile phones, giving a score from 1 to 10 for their initial interest. Next, they were informed that two colleagues would, if additional verbal consent was given, randomly hand them a treat or not. Randomisation was stratified per study centre and was employed by a block-randomisation tool.[33] Due to the nature of the intervention, participants could not be blinded. Participants were explicitly asked to not share the brownie and they could eat it at their own pace. After the presentation, approximately 20 min, they completed the questionnaire, rating the presentation on several domains (content, visual design, new relevant information, outline of the presentation and handling of questions) on a score from 1 to 10. Participants were asked to rate the brownies on a standardised scale regarding look, flavour, texture, quality and value for money (for which a fictional price was provided).[34] We additionally asked whether they would have rated the presentation differently if they had or had not received a treat, thereby gathering insights into participants' perceptions on the influence of the intervention.

Statistics were computed using R V.4.0.3 or newer. A two-sided significance level of 0.05 was used for all primary and secondary analyses and correction for multiple testing was employed, unless stated otherwise. Data was reported as mean (±SD), percentage and range, unless stated otherwise. Statistical models such as logistic, ordinal and linear regression, were constructed according to current standards for model building[35] and statistical tests (t-test, χ^2 and Wald-test) were performed where applicable. Depending on clinical and statistical relevance, models were adjusted for age, gender, occupation and prior knowledge. For regression analysis, assumptions of linearity, homoscedasticity and normality were checked by visual inspection and appropriate statistical tests.[36]

RESULTS

Cross-sectional study

135 participants were included in the CSS: 19 participants from the Princess Máxima Center for Pediatric Oncology, 83 from the Erasmus MC Transplant Institute and 33 from the University Medical Center Groningen, resulting in a response percentage of 67.5%. Baseline characteristics showed no relevant differences between the study centres, see table 1. Mean age was 35.8 years and respondents were mostly working in the clinic (n=93 (68.9%)). At all centres, a clear majority of the respondents were women: 71.6% (n=96). A considerable number of responders were not involved in their day-to-day work with the active clinical trials (91.1%, n=123). Most participants had some knowledge on the concept of fasting (51.1%, n=69), while some had extensive (18.5%, n=25) or no knowledge (30.4%, n=41). Online supplemental appendix A, box 1, focuses on variables related to participants' experiences with IF and/or STF. Out of the total participants, 59 (43.0%) had undergone prior surgery. Prior to surgery, 1 participant reported following a diet with increased caloric content, 1 with reduced caloric content and the remaining 57 participants reported not having had a preoperative diet. In terms of dieting in general, 71 (52.6%) participants reported having self-adhered to a specific diet, while 64 (47.4%) participants had not. The self-adhered diets included various types such as a reduced carbohydrate (n=10), and calorie-restricted diets (n=35). Forty-six (34.1%) participants reported having tried fasting and the most common type of IF tried was the 16/8 hours scheme (n=36, 78.3%). One hundred and four (77.0%) participants stated that they would consider fasting before surgery, with the three most prevalent reasons being: potential beneficial effect on their short-term health (n=74, 71.2%), potential beneficial effect on long-term health (n=81, 77.9%) and potentially reducing burden of medical procedures (n=72, 69.2%). In the 8 (5.9%) participants who would not consider fasting before surgery, the most common reason was the additional mental burden (n=2). The remaining 23 (17.0%) respondents were not sure if they would adhere to a diet before surgery and most gave no specific reason for this (n=14, 60.9%). Regarding overall health, two variables were found to be determinants in regression analysis: prior knowledge and previously adhering to a fasting diet. Participants with self-rated little knowledge (OR 0.30, p=0.027) or no knowledge (OR 0.28, p=0.029) were less likely to consider fasting beneficial. Additionally, participants who had tried fasting were more likely to perceive it as beneficial (OR 6.74, p=<0.001). The second analysis focused perceptions on diets before surgery: participants with self-rated little knowledge (OR 0.23, p=0.015) or no knowledge (OR 0.18, p=0.007) were less likely to consider fasting beneficial. Having tried fasting was not a significant predictor (OR 1.66, p=0.19). The ordered logistic regression analysis, which produced similar results, see tables 2 and 3.

Randomised experiment

A total of 65 participants were included in the randomised experiment. Thirty-four participants were randomised to the control group and 30 to the intervention. One subject declined to be randomised, did complete the post-presentation survey, but was excluded

Table 1 Baseline characteristics of participants who completed the survey

	Máxima	Erasmus MC	UMCG	Total
Number of participants	19 (14.1)	83 (61.5)	33 (24.4)	135 (100)
Age				
Mean (SD)	35.2 (14.1)	37.8 (12.9)	31.4 (9.3)	35.8 (12.5)
Range	22.0–63.0	19.0–72.0	20.0–60.0	19.0–72.0
Occupation group				
Clinician	10 (52.6)	54 (65.1)	29 (87.9)	93 (68.9)
Research	6 (31.6)	13 (15.7)	3 (9.1)	22 (16.3)
Paramedics	3 (15.8)	1 (1.2)	0 (0.0)	4 (3.0)
Administrative worker	0 (0.0)	9 (10.8)	1 (3.0)	10 (7.4)
Student	0 (0.0)	6 (7.2)	0 (0.0)	6 (4.4)
Gender				
Male	5 (26.3)	25 (30.5)	8 (24.2)	38 (28.4)
Female	14 (73.7)	57 (69.5)	25 (75.8)	96 (71.6)
Study personnel				
Study personnel	5 (26.3)	7 (8.4)	0 (0.0)	12 (8.9)
Very frequent contact	1 (5.3)	5 (6.0)	2 (6.1)	8 (5.9)
Some contact	0 (0.0)	15 (18.1)	9 (27.3)	24 (17.8)
Very limited contact	3 (15.8)	16 (19.3)	4 (12.1)	23 (17.0)
No, never	10 (52.6)	40 (48.2)	18 (54.5)	68 (50.4)
Knowledge				
Extensive	6 (31.6)	14 (16.9)	5 (15.2)	25 (18.5)
A little	10 (52.6)	43 (51.8)	16 (48.5)	69 (51.1)
No	3 (15.8)	26 (31.3)	12 (36.4)	41 (30.4)

Data is presented as (N (%)).
Erasmus MC, Erasmus MC Transplant Institute; Máxima, Princess Maxima Center for Pediatric Oncology; SD, standard deviation; UMCG, University Medical Center Groningen.

from the analysis, see also figure 1. Forty-four (68.8%) participants were included at the Princess Máxima Center and 20 (31.2%) at the Erasmus MC Transplant Institute. Baseline characteristics were comparable: we found no significant differences in terms of age, occupation, gender, whether they liked brownies, etc. See also table 4. Baseline comparison of prior interest score did not reveal a statistically significant difference (7.9 vs 7.4, p=0.1342) between the two groups. A linear model confirmed no baseline difference in prior interest score between both groups. When comparing the study arms, a t-test did not yield a statistically significant difference in total score given, (8.07 vs 7.9, p=0.3525). A linear model analysis showed that age (p<0.001), gender (p=0.014) and study personnel status (p=0.020) were significantly associated with the final score. Female participants (−0.54 points), study personnel (−0.66 points) and older participants (−0.05 points per year) rated the presentation lower. There was no statistically significant effect due to brownie-intervention (p=0.495). A separate model which did not adjust for baseline score yielded similar results. See table 5 for the specific scores, and statistical significance. Additionally, the effect of the treats on subscores were examined; t-tests revealed no significant differences. Two linear regression models were constructed per domain, one correcting for baseline differences. Every model showed that higher age resulted in a lower score given. Additionally, visual design score was rated significantly lower by study personnel (−1.02, p=0.02) and relevant information was rated significantly lower by female participants (−0.77, p=0.03). None of the other variables, including randomisation, had any significant effect. Scoring of the study intervention was highly favourable overall, see online supplemental appendix B for all findings. Regarding the participants' perceptions on the influence of the intervention on the given score, we found that in the intervention group, 20 participants (66.7%) responded with 'No', 8 (26.7%) responded with 'lower' and 2 (6.67%) with 'higher' score given, if they had not received the intervention. Out of the 34 control participants, 27 (77.1%) responded with 'No' and 8 (22.9%) responded with 'higher' given score, when they would have received the brownie. See online supplemental appendix C for this analysis.

Box 1 Clarification on nomenclature

Nutritional preconditioning

Nutritional preconditioning has emerged as a subject of extensive investigation, for instance but not limited to, the fields of ageing and cancer research. The term 'nutritional preconditioning' refers to the concept of using specific dietary interventions to prepare the body for potential challenges or stressors, such as ageing processes or cancer treatments. To ensure clarity and avoid confusion caused by varying nomenclature, it is important to provide brief explanations of the commonly referenced interventions.

Caloric restriction

Caloric restriction involves reducing calorie intake while maintaining adequate nutrition, often by consuming a diet with lower energy content than the individual's typical energy expenditure. This approach has shown promising effects in extending lifespan and mitigating age-related diseases in various organisms. Nutritional intake is allowed whenever, but total caloric intake is generally reduced by 20–40%. It is often confused with dietary restriction, but these diets effect the balance of macronutrients, changing the composition of the diet.

Fasting

Fasting refers to periods of abstaining from caloric intake for a defined duration, typically ranging from several hours to a few days. This practice has attracted attention due to its potential to enhance the efficacy of cancer therapies, reduce side effects and improve patient outcomes, but also for religious regions (Ramadan and Lent). Different forms of fasting exist, such as short-term, intermittent or fasting-mimicking diets. Fasting can be applied once short-term or periodically as intermittent. Short-term fasting means no food intake for a given period, in the range of days. This is implemented repeatedly in intermittent fasting, where periods of normal consumption are alternated with fasting. A fasting-mimicking diet is a diet slightly higher in caloric intake than short-term fasting and is typically applied for a longer period and is generally synthetic in nature.

DISCUSSION

This exploratory study shows that providing your audience with treats does not influence their opinion of the presenter or the research presented. It seems that hospital personnel, from academics to clinicians, cannot be bought with treats, in this case a brownie and will stay critical of presented findings. Given the results of the randomised experiment, we conclude that randomisation resulted in a balanced distribution across groups, ensuring that any observed differences can be attributed to the brownie-intervention. The scoring of the treat itself raised no concerns, confirming a potentially effective intervention. The lack of treatment effect on post-presentation scores suggests that receiving a treat did not have a substantial impact on participants evaluations, even when accounting for factors such as baseline expectations, age, occupation and gender. We did observe that younger individuals tended to rate the presentation as more interesting and that female participants rated significantly lower. An interaction of gender and intervention was statistically non-significant, raising no concerns of potential effect modification by gender. This was not as expected, given that on average, women tend to crave sweet treats more than men.[37 38] Lastly, study personnel were found to significantly rate lower, influenced by their involvement in the active trials,[29–31] possibly setting higher standards for the coordinating investigator or they were just sad to see a familiar batch of brownies distributed to others. The consistent findings in the subscores support the absence of the 'Brownie-Effect'. The provided insight into participants' perceptions on the influence of the treat was deemed crucial, given the irony of receiving a calorie-rich treat while being informed about the potential health benefits of restricting calories. In the group who did receive a brownie, about one in four indicated that they would have rated the presentation lower if they had not received it, suggesting that they think that the treat had a positive effect. Interestingly, only 6.7% reported that they would have rated the presentation higher if they had not received the treat. We hypothesise that they truly understood the presented benefit of fasting and that the randomised treat they received, contradicted the information provided. The alternative, not liking the treat, was deemed implausible given that they had scored the brownie consistently high. So, only two participants found it questionable whether you can have your brownie and eat it too.[14] This similar finding was not present in the group who did not receive a treat.

When going more in-depth in our orientating survey, it is notable that most had not followed a specific diet prior to surgery. The findings regarding adherence to diets and/or fasting showed that fasting was relatively common. This indicates interest in IF and/or STF as an approach for improving health. Participants most often cited the expected potential beneficial effects on their short-term and long-term health as important. However, it is important to note that a considerable number did not adhere to any specific diet. The limited mention of

Table 2 Results of the logistic and ordinal regression analysis: General Health

	Logistic regression			Ordinal regression		
	Estimate	OR (95% CI)	P value	Estimate	OR (95% CI)	P value
Knowledge: a little	−1.2086	0.30 (0.10 to 0.85)	<0.05	−1.166	0.31 (0.11 to 0.84)	<0.05
Knowledge: none	−1.2902	0.28 (0.08 to 0.85)	<0.05	−1.289	0.27 (0.09 to 0.80)	<0.05
Adhered before: yes	1.9074	6.74 (2.98 to 16.40)	<0.001	1.799	6.05 (2.71 to 14.51)	<0.05

CI, confidence interval; OR, odds ratio.

Table 3 Results of the logistic and ordinal regression analysis: Surgery

	Logistic regression			Ordinal regression		
	Estimate	OR (95% CI)	P value	Estimate	OR (95% CI)	P value
Knowledge: a little	−1.4525	0.23 (0.06 to 0.70)	<0.02	−1.4426	0.24 (0.06 to 0.70)	<0.05
Knowledge: none	−1.6980	0.18 (0.05 to 0.58)	<0.02	−1.7468	0.17 (0.04 to 0.55)	<0.05
Adhered before: yes	0.5064	1.66 (0.77 to 3.65)	0.1985	0.4431	1.56 (0.73 to 3.41)	NS

CI, confidence interval; NS, non-significant; OR, odds ratio.

religious or personal reasons, such as the implications of dieting on one's family, suggests that personal beliefs do not have a strong influence, providing opportunity for informed shared decision-making. Individuals who adhered to IF and/or STF were more likely to perceive it as beneficial for their general health and those with limited knowledge were less likely.

The combination of these two studies has certain limitations. In the CSS, there is a possibility of selection bias due to the nature of the invitation, which may have attracted individuals with a greater interest in fasting. This could lead to an overestimation of who has experience with and would be willing to try fasting. In the RCT, the intervention itself could have influenced the presentation score in conflicting ways, effectively cancelling itself out. Participants who received a treat but did not pay attention to the presentation, delighted by the sweet treat, might have missed the message about the benefits of fasting. Those who paid attention, not having received a treat, might have realised that not receiving the brownie was more beneficial. This effect could be more pronounced due to a 'sugar rush' or a

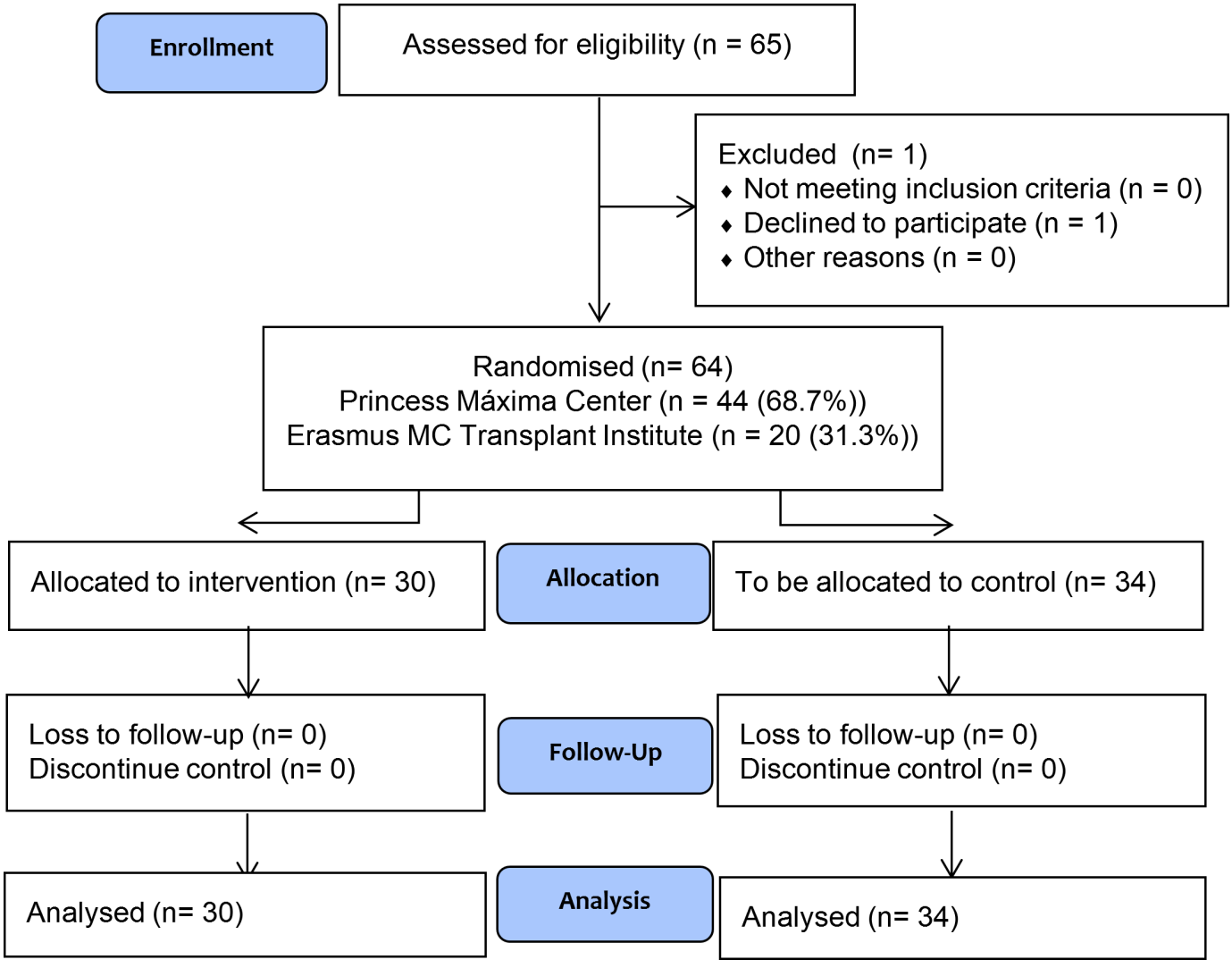

Figure 1 Flowchart of the randomised experiment.

Table 4 Baseline comparison for the randomised experiement

	Control	Intervention	Total
Number of participants	34 (53.1)	30 (46.9)	64 (100)
Age			
Mean (SD)	34.2 (10.3)	32.4 (10.8)	33.4 (10.5)
Range	23–58	22–59	22–59
Centre			
Máxima	27 (79.4)	17 (56.7)	44 (68.8)
Erasmus MC	7 (20.6)	13 (43.3)	20 (31.2)
Occupation group			
Clinician	4 (11.8)	11 (36.7)	15 (23.4)
Research	27 (79.4)	14 (46.7)	41 (64.1)
Paramedics	2 (5.9)	1 (3.3)	3 (4.7)
Student	1 (2.9)	4 (13.3)	5 (7.8)
Gender			
Missing	2	0	2
Male	9 (28.1)	11 (36.7)	20 (32.3)
Female	23 (71.9)	19 (63.3)	42 (67.7)
Study personnel: yes	3 (8.8)	4 (13.3)	7 (10.9)
Prior knowledge: yes	28 (82.4)	22 (73.3)	50 (78.1)
Like brownies: yes	30 (88.2)	27 (90.0)	57 (89.1)

Data is presented as (N (%)).
Erasmus MC, Erasmus MC Transplant Institute; Máxima, Princess Maxima Center for Pediatric Oncology; SD, standard deviation.

'sugar dip', caused by the caloric strain due to the treat. However, the caloric strain of the brownie could have been lessened by the high cocoa content, as polyphenol seems to have a protective effect[8 9] and is highly prevalent in the provided treat. We could have corrected for this if we had measured blood glucose, but due to the strictly non-invasive nature of the study,[39] we were not able to do so. Consequently, their scoring habits could have balanced each other, explaining the lack of significant results. Also, cross-contamination could not be ruled out; control participants were potentially visually stimulated by the presence of treats. Additionally, we did not ask participants if they were adhering to a diet, impacting the acceptability of the treat. We were also not able to see if there could be a change due to repeated exposure of brownies, but this could be explored in the future. It is important to note that the intervention itself was well-tolerated and even well-received, not raising concern of an ineffective treatment. Another notable limitation was a potential time-of-day effect. Sadly, the number of participants was not high enough to discern whether a time-of-day effect would influence effect, aside from a potential study centre specific effect. The research meeting at

Table 5 Primary linear model on score given (total score of all domains for the presentation, range from 1 to 10)

	Estimate	SE	T value	P value
(Intercept)	7.628	0.66628	11.449	<0.001
Randomisation: brownie	0.125	0.18176	0.687	0.495
Baseline score	0.339	0.08537	3.970	<0.001
Age	−0.048	0.01023	4.723	<0.001
Occupation group: research	−0.430	0.22292	−1.929	0.059
Occupation group: paramedics	0.876	0.55610	1.575	0.1212
Occupation group: student	−0.235	0.37803	−0.621	0.5373
Gender: female	−0.545	0.21451	−2.540	0.0140
Study personnel: yes	−0.659	0.27379	−2.405	0.0197

one site was held in the morning, while the other was held in the afternoon. An effect modification due to time seems plausible, but in our study we did not find a study centre-related effect, which would encompass both the effect of time and the between-centres differences. With our number of participants we cannot reliably conclude that a time-of-day modification effect was absent, but we do consider the possibility that it has played an effect which could be explored in future studies.

CONCLUSION

In this light-hearted, holiday-inspired exploratory study offering treats, we found that providing your audience with treats does not influence participants' opinion of you or your research. Delving into the motivations of participants, we observed that experiences varied, with a majority not following specific diets. Among those who did adhere to a specific diet, IF and STF were a popular choice. Participants who considered fasting believed it could have potential short-term and long-term health benefits and personal experience played a significant role. In summary, it seems that people cannot be bought with treats, will stay critical of presented findings and due to prior experiences will be receptive to the counterintuitive topic of fasting. Most importantly, what this study did prove irrefutably, is that treating healthcare workers has the extraordinary ability to turn serious of projects into a light-hearted social scientific adventure.

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REFERENCES

1 Hamburg ME, Finkenauer C, Schuengel C. Food for love: the role of food offering in empathic emotion regulation. *Front Psychol* 2014;5:32.
2 Dunbar RIM. Breaking bread: the functions of social eating. *Adapt Human Behav Physiol* 2017;3:198–211.
3 Salvy SJ, Jarrin D, Paluch R, *et al*. Effects of social influence on eating in couples, friends and strangers. *Appetite* 2007;49:92–9.
4 Di Fabio A, Palazzeschi L, Bucci O. Gratitude in organizations: a contribution for healthy organizational contexts. *Front Psychol* 2017;8:2025.
5 Willman J, Lucke-Wold B. An approach to improving clinical morale: targeting a positive culture. *Res Adv Pharm Life Sci* 2021;3:36–9.
6 Oudmaijer CAJ, Pol RA, Minnee RC, *et al*. Chocolate brownies and calorie restriction: the sweetest paradox? *BMJ* 2023.
7 Robin-Champigneul F. Jeanne Calment's unique 122-year life span: facts and factors; longevity history in her genealogical tree. *Rejuvenation Res* 2020;23:19–47.
8 Chen L, Zhu H, Gutin B, *et al*. Higher chocolate intake is associated with longer telomere length among adolescents. *Pediatr Res* 2020;87:602–7.
9 Galleano M, Oteiza PI, Fraga CG. Cocoa, chocolate, and cardiovascular disease. *J Cardiovasc Pharmacol* 2009;54:483–90.
10 de Groot S, Lugtenberg RT, Cohen D, *et al*. Fasting mimicking diet as an adjunct to neoadjuvant chemotherapy for breast cancer in the multicentre randomized phase 2 DIRECT trial. *Nat Commun* 2020;11:3083.
11 de Cabo R, Mattson MP. Effects of intermittent fasting on health, aging, and disease. *N Engl J Med* 2019;381:2541–51.
12 Jongbloed F, de Bruin RWF, Steeg HV, *et al*. Protein and calorie restriction may improve outcomes in living kidney donors and kidney transplant recipients. *Aging (Albany NY)* 2020;12:12441–67.
13 van den Boogaard WMC, van den Heuvel-Eibrink MM, Hoeijmakers JHJ, *et al*. Nutritional preconditioning in cancer treatment in relation to DNA damage and aging. *Annu Rev Cancer Biol* 2021;5:161–79.
14 Ingram DK, Roth GS. Calorie restriction mimetics: can you have your cake and eat it, too. *Ageing Res Rev* 2015;20:46–62.
15 Longo VD, Mattson MP. Fasting: molecular mechanisms and clinical applications. *Cell Metab* 2014;19:181–92.
16 López-Otín C, Galluzzi L, Freije JMP, *et al*. Metabolic control of longevity. *Cell* 2016;166:802–21.
17 Lee MB, Hill CM, Bitto A, *et al*. Antiaging diets: separating fact from fiction. *Science* 2021;374:eabe7365.
18 Grundmann F, Müller R-U, Reppenhorst A, *et al*. Preoperative short-term calorie restriction for prevention of acute kidney injury after cardiac surgery: a randomized, controlled, open-label, pilot trial. *J Am Heart Assoc* 2018;7:e008181.
19 Kip P, Trocha KM, Tao M, *et al*. Insights from a short-term protein–calorie restriction exploratory trial in elective carotid endarterectomy patients. *Vasc Endovascular Surg* 2019;53:470–6.

20 Reeves JG, Suriawinata AA, Ng DP, *et al*. Short-term preoperative diet modification reduces steatosis and blood loss in patients undergoing liver resection. *Surgery* 2013;154:1031–7.
21 van Ginhoven TM, de Bruin RWF, Timmermans M, *et al*. Pre-operative dietary restriction is feasible in live-kidney donors. Clin Transplant 2011;25:486–94. 10.1111/j.1399-0012.2010.01313.x Available: https://onlinelibrary.wiley.com/toc/13990012/25/3
22 Van Nieuwenhove Y, Dambrauskas Z, Campillo-Soto A, *et al*. Preoperative very low-calorie diet and operative outcome after laparoscopic gastric bypass: a randomized multicenter study. *Arch Surg* 2011;146:1300–5.
23 Wolf RM, Oshima K, Canner JK, *et al*. Impact of a preoperative low-calorie diet on liver histology in patients with fatty liver disease undergoing bariatric surgery. *Surg Obes Relat Dis* 2019;15:1766–72.
24 Zhan C, Dai X, Shen G, *et al*. Preoperative short-term fasting protects liver injury in patients undergoing hepatectomy. *Ann Transl Med* 2018;6:449:449.:.
25 Haines A, Donald A. Making better use of research findings. *BMJ* 1998;317:72–5.
26 Hankey CR, Eley S, Leslie WS, *et al*. Eating habits, beliefs, attitudes and knowledge among health professionals regarding the links between obesity, nutrition and health. *Public Health Nutr* 2004;7:337–43.
27 Marko S, Wylie S, Utter J. Enablers and barriers to healthy eating among hospital nurses: a systematic review. *Int J Nurs Stud* 2023;138:104412.
28 Ziauddeen H, Subramaniam N, Cambridge VC, *et al*. Studying food reward and motivation in humans. *J Vis Exp* 2014;2014:51281.
29 Oudmaijer CAJ, Berk KA, van der Louw EJTM, *et al*. Ketogenic diet therapy in patients with hepatocellular adenoma: study protocol of a matched Interventional cohort study. *BMJ Open* 2022;12:e053559.
30 Oudmaijer CAJ, Minnee RC, Pol RA, *et al*. Fasting before living-kidney donation: effect on donor well-being and postoperative recovery: study protocol of a multicenter randomized controlled trial. *Trials* 2022;23:18.
31 Oudmaijer CAJ, van den Boogaard WMC, Komninos DSJ, *et al*. Fasting intervention for children with unilateral renal tumors to reduce toxicity. *Front Pediatr* 2022;10:828615.
32 Park JJH, Siden E, Zoratti MJ, *et al*. Systematic review of basket trials, umbrella trials, and platform trials: a landscape analysis of master protocols. *Trials* 2019;20:572.
33 Microsoft Corporation. Microsoft excel. 2018. Available: https://office.microsoft.com/excel
34 Wichchukit S, O'Mahony M. The 9-point hedonic scale and hedonic ranking in food science: some reappraisals and alternatives. *J Sci Food Agric* 2015;95:2167–78.
35 Rizopoulos D. DRizopoulos. 2023. Available: https://www.drizopoulos.com
36 Riley RD, Cole TJ, Deeks J, *et al*. On the 12th day of Christmas, a statistician sent to me. *BMJ* 2022;379:e072883.
37 Weingarten HP, Elston D. Food cravings in a college population. *Appetite* 1991;17:167–75.
38 Zellner DA, Garriga-Trillo A, Rohm E, *et al*. Food liking and craving: a cross-cultural approach. *Appetite* 1999;33:61–70.
39 Loudon K, Treweek S, Sullivan F, *et al*. The PRECIS-2 tool: designing trials that are fit for purpose. *BMJ* 2015;350:h2147.