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ORIGINAL ARTICLE

Can implementation intentions increase fibre intake? An examination of the effect of planning and educational information

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Abstract

Healthy eating is a main concern to public policy. Despite the public attention that overweight and obesity has received in recent years, research is still short of evidence about fiber consumption, even though fiber intake represents the third pillar of a healthy diet. This study assesses whether a volitional intervention based on goal planning and educational information raises fiber intake among healthy individuals. We test the effectiveness of implementation intentions accompanied by educational information on fiber intake in a 2x2x2 experiment with 205 university students. The results show that fiber intake did not significantly increase. However, the groups that had made plans for goal attainment narrowed their intention-behavior gap, and those receiving educational information had more knowledge about fiber-rich food. These results are puzzling as fiber intake meets the conditions where implementation intentions would work best. The authors suggest that to raise fiber intake, a combined strategy that involves manufacturers, public authorities and health professionals is needed to create a supportive environment so that individuals can successfully implement their plans.

Keywords Healthy diet · Implementation intentions · Goal planning · Education · Fiber intake

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1 Introduction

1.1 Healthy Eating and Fiber

Healthy eating is a main concern to public policy, due to the problems caused by overweight and obesity (e. g. 38 million children under the age of 5 were overweight or obese in 2019; childhood obesity is one of the most serious public health challenges of the 21st century because overweight children are likely to become obese adults.) (World Health Organization, 2020). According to World Health Organization, obesity has reached epidemic proportions globally, there are 2.8 million people dying each year as a result of being overweight or obese. Governments, companies, non-governmental organizations and civil society all have vital roles to play in contributing to obesity prevention. Reducing the global obesity epidemic requires a population-based multi-disciplinary, multisectoral, and culturally relevant approach.

For an individual, obesity is usually the result of a non-adequate between calories consumed and calories expended. Diet plays a relevant role because an increased consumption of energy dense foods, without an equal increase in physical activity, leads to an unhealthy increase in weight. There are three conditions for a healthy diet (World Health Organization, 2003): to limit energy intake (reducing fat intake and sugar consumption), to increase consumption of vegetables and fruit, and to raise fiber intake (consuming more legumes, whole grains and nuts). Fiber intake is thus the third pillar of a healthy diet. Raised fiber intake has been found to decrease the incidence of colorectal cancer (Aune et al., 2011) and cardiovascular diseases (Threapleton et al., 2013) among others.

Despite this evidence, the consumption of fiber remains low (Howarth et al., 2009; Mobley et al., 2014; Thompson & Brick, 2016). Several factors contribute to the "fiber gap" (Clemens et al., 2012; Mobley et al., 2014). The benefits of fiber intake are long term, the clinical symptoms of low fiber intake are not directly evident, consumers self-perceive that they are eating enough fiber, and there is much confusion among consumers about fiber-rich food (Lyly et al., 2004; Mobley et al., 2014). For these and other reasons, fiber intake is less of an immediate concern to both health professionals and consumers compared to fruit, vegetable and fat intake (Clemens et al., 2012).

Additionally, research on the promotion of healthy eating has overlooked fiber. Extant research has examined perceptions of fiber-rich food (Ginon et al., 2009) or self-perceptions of fiber intake (Lyly et al., 2004), but to the best of our knowledge, no study has focused on the promotion of fiber-rich diets. As has been the case with the other dietary recommendations (Adriaanse et al., 2009; Brug et al., 2006; Chapman & Armitage, 2012; de Nooijer et al., 2006; Luszczynska et al., 2016), volitional interventions have proven successful in helping individuals follow dietary recommendations. Thus, we chose a volitional intervention to raise fiber intake among healthy individuals.

This is to our knowledge the first study that focuses specifically on the effect of implementation intentions (II hereafter) on fiber intake and that tests the effect of

educational information on goal enactment and on the efficacy of planning. The target behavior (increasing fiber intake) meets the conditions whereby II work best; yet, there were not significant differences between experimental and control groups. This paper contributes to existing literature by showing that volitional interventions are not effective at increasing fiber intake when there is missing a supportive environment for these individually-devised plans. Educational information increases knowledge of fiber-rich food; yet, being knowledgeable is a necessary but not sufficient condition to increase fiber-intake. The paper provides recommendations for policy makers in order to create a supportive environment that facilitate the actual implementation of the devised plans.

1.2 Volitional Interventions: Implementation Intentions

Past studies on healthy eating have shown that motivation is a necessary but not sufficient condition for the adoption of a healthy diet. Motivation has usually been studied using the theory of planned behavior (Ajzen, 1991) (TPB), the dominant motivational framework in health psychology (Armitage, 2003). The TPB has shown good predictive validity in reducing fat intake (Scholz et al., 2009; Soureti et al., 2012a, b) and increasing the consumption of fruits and vegetables (Brug et al., 2006; Luszczynska et al., 2007a, b).

However, even if they are highly motivated and their intentions are strong, people often do not achieve their goals. That is, people may have the intention to follow a healthy diet; however, they may forget about it in certain situations, such as when they go to a restaurant, or when they are hungry and healthy food is unavailable, or they may face difficulties in overcoming "temptations" when they are under stress. In these situations, although forming goal intentions is a necessary condition and positively affects goal pursuit, it does not guarantee the realization of one's wishes and desires; therefore, the desired outcome may not be effectively achieved (Gollwitzer, 1993). When motivation is not enough, volition plays an important role.

Volitional interventions (Gollwitzer, 1999) have long been used as health interventions aiming to help individuals achieve healthy eating goals (Adriaanse et al., 2010). In particular, implementation intentions (II hereafter) have been found to raise fruit and vegetable intake (Armitage, 2007, 2015; Djuric et al., 2010; Luszczynska et al., 2007a, b) and to diminish fat intake (Luszczynska et al., 2007a, b; Scholz et al., 2009; Schwarzer & Luszczynska, 2008; Soureti et al., 2012a, b). II interventions have also demonstrated their efficacy when used in other domains such as smoking (Armitage, 2008), savings (Soman & Zhao, 2011), contraceptive use (Vet et al., 2011) or alcohol consumption (Murgraff et al., 1996).

II are anticipatory plans adopting an "if-then" form that specifies "*when*, *where* and *how*" one intends to act and linking a situational cue with an action (Gollwitzer, 1999). Whereas the goal intention commits a person to achieving a goal (Bagozzi & Dholakia, 1999), II lay out a specific plan that helps initiate goal-directed activity and commitment to executing an intended goal-directed behavior (Gollwitzer, 1993). That is, goal intentions take the format of "I intend to achieve *x*", where *x* specifies the desired end state, which may be defined abstractly or concretely (e.g.,

getting to know a certain person *versus* inviting that person to dinner). II take the form of "I intend to do *y* when situation *z* is encountered" in anticipation of a future situation (opportunity) to act. II are thus plans to attain goal intentions (Dewitte et al., 2003). II work because of two mechanisms (Gollwitzer & Oettingen, 1998): salience and automatization. II raise salience as they make the individual pre-identify the appropriate moments to act, and they lead to automatization as individuals mentally link these moments to an action. Every time a situational cue occurs, the person will carry out the pre-planned behavior, which is something that can be done with little deliberation or even consciousness. II are also called action plans.

II have been widely adopted in health promotion plans because they have proven successful in narrowing the gap between goal intention and behavior for different types of goals, as shown in previous meta-analyses (Adriaanse et al., 2011; Bélanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006). Thus, interventions that enhance motivation and volition should be effective in changing behavior in general (Prestwich & Kellar, 2014).

However, studies on volitional interventions in healthy eating have offered mixed evidence about their effectiveness. Whereas II have had a medium-large effect on fruit and vegetable consumption (Armitage, 2007; Knäuper et al., 2011; Luszczynska et al., 2016; Thompson et al., 2015), their effect on other healthy eating habits (e.g., reducing fast-food consumption or fat intake) has been medium-low or low (Karimi-Shahanjarini et al., 2013; Prestwich et al., 2008; Schroder, 2010; Tapper et al., 2014)[1].

Research has accounted for these differences by identifying key mediating and moderating factors of II and goal achievement (Dewitte et al., 2003). The most relevant factors have been included in this study: motivation, difficulty and type of goal. First, past research has shown that II facilitate goal achievement when individuals are mildly motivated to achieve the goal, as opposed to when they are weakly or strongly motivated (Gollwitzer & Brandstätter, 1997). Second, II were found to be more effective when the target behavior was difficult (Dewitte et al., 2003; Luszczynska et al., 2007a, b). Finally, interventions based on II have been more effective with approach-like goals than with avoidance-like goals (Adriaanse et al., 2010); the former promote a certain behavior to achieve a goal (e.g., eating fiber), whereas the latter prevent a certain behavior to achieve a goal (e.g., not eating unhealthy snacks).

1.3 Increasing Fiber Intake

The goal of increasing fiber intake meets these three conditions. Past research has shown that consumers are only mildly concerned about their own fiber intake, usually because they wrongly believe that they are meeting dietary recommendations (Lyly et al., 2004). Additionally, increasing fiber intake is a more difficult goal than other previously examined healthy eating goals, such as eating more fruit and vegetables or reducing snacking. As research has found, consumers lack knowledge of

[1] According to Cohen's (1992) power primer, $d = .20$ represents a "small" effect, $d = .50$ represents a "medium"-sized effect, and $d = .80$ represents a "large" effect.

fiber-rich food, or they wrongly believe that they are following dietary recommendations when in fact the chosen food is not as fiber rich as other alternatives (Lyly et al., 2004; Mobley et al., 2014). Finally, raising fiber intake is an approach-type goal. As the goal of increasing fiber meets these three conditions, II should successfully help in the attainment of this goal.

However, one potential barrier to the effectiveness of II in increasing fiber intake is limited knowledge on the fiber content of food (Clemens et al., 2012; Variyam et al., 1996). As previous literature found, knowledge and educational activities are important to educate population in health issues (Biroscak et al., 2008). If individuals are not familiar with fiber-rich food, salience and automatization, the two mechanisms that make II work will be compromised, as individuals will be unable to detect good opportunities to act. Worse, they may also devise the wrong plans, including selecting food that is not fiber rich (e.g., eating one kiwi a day when a handful of peanuts would be a much more fiber-rich choice). Information will help individuals not only determine the best course of action to achieve the goal but also devise action plans, that is, II. Action plans and II are plans focused on actions rather than goals. When individuals are knowledgeable about fiber content, they can devise more focused action plans; i.e., they plan how to introduce fiber-rich food into their diet instead of planning for a vague goal of "raising fiber". Action plans have been found to be more effective than goal plans (Dewitte et al., 2003). Thus, some educational treatment prior to the individual's planning could increase the effectiveness of II.

1.4 Educational information

Literature focuses on another relevant aspect, knowledge and education; these factors also influence dietary behaviors (Pérez-escamilla et al., 2008; Sharma et al., 2008) and the results obtained in II interventions.

Other studies that included a health training to increase participants' knowledge presented similar results. In an experiment by Zhang and Cooke, the researchers included a leaflet that recommended different options for healthy eating behaviors. The results confirmed the success of an effective health education intervention that made participants feel that it was not difficult to follow the dietary recommendations (Zhang & Cooke, 2012). Other examples include that provided a nutrition education program to patients who wished to change their dietary habits using implementation intentions (Luszczynska et al., 2007a, b) and studies that offered brief nutrition education to achieve the necessary level of knowledge (Scholz et al., 2013). These results further support the idea of food literacy in overcoming barriers to healthy eating (Wijayaratne et al., 2018).

Previous studies have not used educational information as an experimental variable: either subjects in both the experimental and the control conditions received educational information (Karimi-Shahanjarini et al., 2013; Luszczynska & Haynes, 2009; Scholz et al., 2013), or no subjects received it (Adriaanse et al., 2009; Chapman & Armitage, 2012; de Nooijer et al., 2006; Guillaumie et al., 2012; Zhang & Cooke, 2012). Given the methods used in previous studies, it is not possible to

isolate the causal effect of this variable on the effectiveness of II. In this study, educational information is considered as an experimental variable to clarify its relationship on the effectiveness of II. Educational information easy to understand is included as a variable in this study, taking into account that literacy problems within a considerable proportion of the population has been shown that information provided as part of interventions may not be readily comprehended by citizens (Kemp & Eagle, 2008). Being informed about fiber-rich foods will increase knowledge, but if individuals do not plan for how to attain the goal, fiber intake will not significantly increase. We thus hypothesize that educational information alone will not increase fiber intake unless accompanied by the formulation of II.

Thus, this paper aims to test the following hypotheses.

H1: The use of II increases fiber intake.increasing the consumption of fruits and vegetables
H2a: Educational information alone does not increase fiber intake.
H2b: The combined use of II and educational information leads to greater fiber intake than the use of II alone.

2 Methods

The sample comprised students from several universities, business schools and the University for the Elderly who were attending diverse graduate and undergraduate programs. Like the majority of previous experiments on II (Adriaanse et al., 2009; Chapman et al., 2009 among others), a student sample was used in this case because students are more willing to change their attitude (Krosnick & Alwin, 1989) and tend to present higher degrees of self-monitoring (Reifman et al., 1989). At baseline, 357 questionnaires were distributed, of which 295 were completed. At follow-up, 205 participants completed the questionnaire, for a follow-up response rate of 69%. The attrition rate was largely due to participants exercising their right to withdraw from the study. The final sample was aged predominantly between 20 and 30 years (82%), and 3% were older than 40; 38% were male.

A randomized controlled study design was used, with motivation (TPB variables), fiber knowledge and fiber intake being assessed at baseline and at follow-up 2 weeks later. Participants were randomly assigned to conditions in a 2 (intervention format: control vs. II) x 2 (baseline educational information: educational information vs. no educational information) x 2 (time: baseline vs. follow-up) mixed design.

Participants were asked to participate in a study on dietary habits. At baseline, all participants were informed of the health advantages of increasing fiber consumption; previous studies have also included such awareness-raising information (e.g., Chapman et al., 2009). Also, they were asked to complete a questionnaire assessing their motivation, knowledge of fiber-rich food and daily fiber intake. As explained below, participants in the II condition were asked to formulate II; participants in the educational treatment were given information about fiber content of different food elements. Two weeks later, all participants were asked to report their fiber intake

during the previous week. The baseline and follow-up questionnaires were matched on the basis of a self-generated code to ensure the anonymity of the participants.

In the II condition (baseline), participants received detailed instructions on paper for how to formulate their own plans specifying *when*, *where* and how to increase their fiber intake. In particular, subjects were asked to specify *what they would eat* during the following two weeks; thus, they focused on actions, as suggested by other authors in the context of difficult goals (Luszczynska et al., 2007a, b; Sullivan & Rothman, 2008). The instructions suggested forming plans that were as specific as possible. Examples were provided, as this approach has been shown to increase participants' planning ability (Chapman & Armitage, 2010).

In the educational information condition (baseline), participants received a list of food products that have a high fiber content to increase their knowledge of these products. This list was developed based on information from two different health societies (BEDCA, 2007; SEH-LELHA, 2005).

In line with previous II studies (Armitage, 2007; Chapman et al., 2009; Verplanken & Faes, 1999), variables derived from Ajzen's (1991) TPB were used to measure *motivation* using standard items at BASELINE and follow-up. The TPB is adequate to measure motivation for volitional, rather than habitual, goals, which is the case in this study (Armitage 2003). To measure *attitude*, participants were asked to rate the items on three bipolar (-3 to +3) semantic difference scales. Cronbach's α indicated that the attitude scale possessed good internal reliability at baseline (α = .68) and follow-up (α = .75). *Subjective norms* was operationalized using two items that formed an internally reliable scale at baseline (α = .78) and follow-up (α = .86). These were measured by averaging responses made on unipolar (+1 to +7) scales. *Perceived behavioral control* was measured using five items, again using unipolar scales (+1 to +7). The internal reliability of the scale was high at baseline (α = .85) and follow-up (α = .87). Behavioral intention was measured with three items, also using unipolar scales (+1 to +7). Again, reliability was high at baseline (α = .91) and follow-up (α = .89).

Fiber intake behavior was measured at baseline and follow-up by asking participants to report what they had eaten during the previous week from a list of food items that are habitually eaten in the country. Some products that do not contain fiber were inserted into the list to prevent social bias (Verplanken & Faes, 1999) in case participants were looking for answers desired by the researchers. Participants answered two questions: the number of days they had consumed each product and the number of portions per day. The fiber content of each food item was obtained by BEDCA (2007). We obtained the fiber intake by multiplying the scores on these two questions, as was done in previous studies (Karimi-Shahanjarini et al., 2013; Van Osch et al., 2009).

Knowledge of fiber-rich food was measured at baseline and follow-up with an ad hoc scale. At both time points, participants in all conditions received a list of food products and indicated which ones had a high fiber content. The list comprised fiber-rich and non-fiber-rich foods, and all fiber-rich food items had been included in the educational intervention. This variable was coded as the number of correct guesses.

Two types of analyses were performed to test the hypotheses. First, ANCOVA and two-way ANOVA tested the effect of the interventions in the experimental and

control groups. Second, structural equation modelling (SEM) was used to examine whether having formulated II resulted in a better predictive capacity of the TPB, with II introduced as a moderating variable. Additionally, the mediating effect of the educational information was tested by measuring whether the variable *Knowledge* mediated the relationship between *Intentions* and *Behavior*. Statistical analysis was performed with SPSS 15.0 using AMOS for the SEM Analysis (SPSS Inc., Chicago, IL). P values <.05 were considered statistically significant.

3 Results

3.1 Attrition Biases Check

To check attrition biases, the baseline responses (i.e., TPB variables, fiber intake and knowledge) of the follow-up respondents were compared with those of non-respondents using MANOVA. The multivariate test was non-significant, $F(6, 288) = .422$, $p = .864$, $n^2_p = .009$), demonstrating that there were no differences between respondents and non-respondents.

3.2 Randomization Check

The experimental and control conditions were compared for baseline planning, TPB variables, fiber intake and gender to ensure that the randomization was successful. A 2 (intervention: control vs. II) x 2 (baseline educational intervention: educational intervention vs. no educational intervention) MANOVA testing for overall randomization was non-significant for both the II intervention, $F(6, 196) = .859$, $p = .526$, $n^2_p = .026$, and the educational intervention, ($F(6, 196) = 1.144$, $p = .338$, $n^2_p = .034$) as well as the interaction between the two conditions, $F(6, 196) = 1.096$, $p = .366$, $n^2_p = .032$. Gender, income, age, educational level and baseline fiber intake were then tested using univariate ANOVAs. The differences were non-significant for gender, $\chi^2(3) = .383$ and $p = .183$, income, $\chi^2(3) = .088$ and $p = .994$, and educational level $\chi^2(3) = .496$ and $p = .495$. The differences were significant for age, $\chi^2(3) = 8.814$ and $p = .007$, due to the presence of older participants in the control condition. However, there were no differences for baseline fiber intake, $\chi^2(3) = 739.694$ and $p = .857$.

These results suggest that before the manipulation, fiber intake, knowledge of fiber-rich food, and motivation were similar between participants in the experimental and the control groups. Moreover, as expected, motivation was medium-high across groups. Previous research has shown that II are not highly effective in goal attainment when individuals have not enough motivation (Milne et al., 2002; Prestwich & Kellar, 2008; Sheeran et al., 2005; Soureti et al., 2012a, b). Thus, the levels of motivation in this study are deemed adequate for II to work.

Table 1 Means and standard deviations for all variables at all time points. All groups together.

VARIABLE	TIME *p*-value	RESULTS M (SD)
Fibre intake (grams per week)	Baseline	68.23 (53.41)
	Follow-up	68.61 (52.47)
	p-value	.905
Knowledge of fiber-rich food	Baseline	71.28 (13.89)
	Follow-up	77.19 (14.13)
	p-value	.000
Attitude	Baseline	1.24 (1.00)
	Follow-up	1.30 (1.07)
	p-value	.298
Subjective norm	Baseline	3.77 (1.60)
	Follow-up	4.01 (1.56)
	p-value	0.010
Perceived behavioral control	Baseline	5.03 (1.25)
	Follow-up	4.82 (1.28)
	p-value	0.004
Intention	Baseline	4.22 (1.63)
	Follow-up	4.08 (1.48)
	p-value	0.065

3.3 Effects of the Pre-Intervention Instructions and Interventions

The intervention did not result in significant changes in the motivational or behavioral variables (see table 1). T-tests showed that attitude and intention at follow-up were similar to those observed at baseline. However, subjective norms increased and perceived behavioral control diminished at follow-up. Small variations in these variables have been observed in other studies (Clemens et al., 2012).

There was no significant increase in fiber intake at follow-up ($p < .95$), but knowledge of fiber-rich food had increased significantly ($p < .05$), from 71.28% to 77.19%. Regarding fiber intake, the average consumption obtained in this study (<10 grams per day) is lower than the average for the national population (between 16 and 22 grams per day) (Alonso et al., 2006; Estruch et al., 2009; Saura-Calixto & Goñi, 2004). This difference from the national population is probably due to the composition of the sample: many studies have shown that students abandon healthy eating habits when they are at university (FEN, 2016). Thus, the baseline fiber consumption was not too high, which ensured that there was room for improvement (Dewitte et al., 2003).

Table 2 Means and standard deviations for all variables at all time points. Separated by groups.

VARIABLE	TIME	II + EI M (SD)	II M (SD)	EI M (SD)	CONTROL M (SD)
Fibre intake (grams per week)	Baseline	65.44 (65.58)	64.09 (42.74)	69.19 (46.11)	72.43 (58.18)
	Follow-up	69.88 (66.80)	66.82 (50.20)	70.54 (48.96)	67.2 (46.67)
Knowledge of fiber-rich food	Baseline	72.82 (15.18)	70.42 (13.08)	71.54 (14.40)	71.25 (12.35)
	Follow-up	80.96 (13.50)	74.58 (15.56)	79.65 (12.73)	74.69 (13.49)
Attitude	Baseline	1.17 (.95)	1.17 (1.11)	1.19 (1.09)	1.38 (.83)
	Follow-up	1.31 (.93)	1.27 (1.39)	1.14 (1.05)	1.45 (.90)
Subjective norm	Baseline	3.44 (1.62)	4.02 (1.74)	3.65 (1.46)	3.91 (1.59)
	Follow-up	3.78 (1.64)	4.31 (1.59)	3.96 (1.43)	4.00 (1.60)
Perceived behav. control	Baseline	5.23 (1.25)	4.87 (1.36)	4.97 (1.11)	5.06 (1.32)
	Follow-up	5.03 (1.34)	4.74 (1.42)	4.71 (1.15)	4.84 (1.27)
Intention	Baseline	4.23 (1.65)	4.31 (1.80)	4.13 (1.49)	4.21 (1.64)
	Follow-up	3.95 (1.46)	4.25 (1.78)	3.90 (1.37)	4.22 (1.35)

II: Implementation Intentions

EI: Educational Information

3.3.1 Effects of II on Fiber Intake

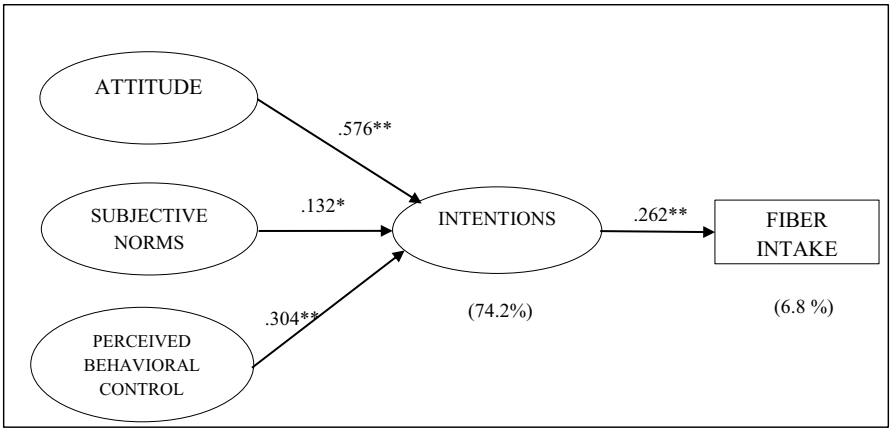
The results of the ANOVA show that II had no effect on fiber intake at follow-up ($M_{II} = 68.32$ vs. $M_{no\ II} = 68.83$; $p = .945$). Hence, II did not lead to increased fiber intake.

3.3.2 Effects of Instruction and Combined Effects of II and Instruction on Fiber Intake

A two-way ANOVA was conducted to examine the main and interaction effects of the experimental variables using the fiber intake difference between baseline and follow-up. The participants in the experimental groups increased their fiber intake, with the highest increase shown by the group that formulated II and received educational information, but the effects were non-significant (II $p = .387$; educational information $p = .668$). Additionally, there was no statistically significant interaction between the effects of II and educational information ($p = .703$). Thus, H1 and H2a were not supported.

3.3.3 Effects of Educational Information on Fiber Knowledge

An ANCOVA was conducted controlling for knowledge at baseline to study the impact of instruction on knowledge (see table 2). There were statistically significant differences in fiber knowledge between the groups that received educational



*p-value < .10; ** p-value < .05

Figure 1 Structural model estimates

information and the groups that did not (F = 2.808; p = .041). Thus, educational information increases fiber knowledge ($M_{educational}$ =79.65, $M_{control}$=74.69). Additionally, the group that both received the information and formulated II presented even greater knowledge (M = 80.96). This likely occurred because participants had to use the information to formulate their plans, which may have helped them recall the fiber-rich food.

3.3.4 II Helped Reduce the Gap between Intention and Behavior

In addition to ANOVA, an SEM model was estimated with five constructs, *Attitude, Subjective Norms, Perceived Behavioral Control, Intentions,* and *Fiber Intake*, to test the effects of II on fiber intake. Following the TPB formulation, *Attitude, Subjective Norms,* and *Perceived Behavioral Control* were specified as antecedents of *Intention*, and *Intention* was specified as a predictor of behavior (fiber intake).

The measurement model was tested for unidimensionality, reliability and validity using confirmatory factor analysis with AMOS, so the constructs were evaluated separately (Anderson & Gerbing, 1988). For all constructs, the unidimensionality was demonstrated by the good values of the fit index in the measurement model (GFI and AGFI around .90 or above in some cases). Reliability was tested by the composite reliability index, whose values were .80 or higher and corroborated the reliability of scales. Validity was demonstrated by the significant and positive factor loadings of the measurement items, average variance extracted (AVE) greater than .50 and square root of AVE greater than .70 5 (Babin et al., 1994; Chin, 1998; Dillon & Goldstein, 1984; Jöreskog & Sörbom, 1993).

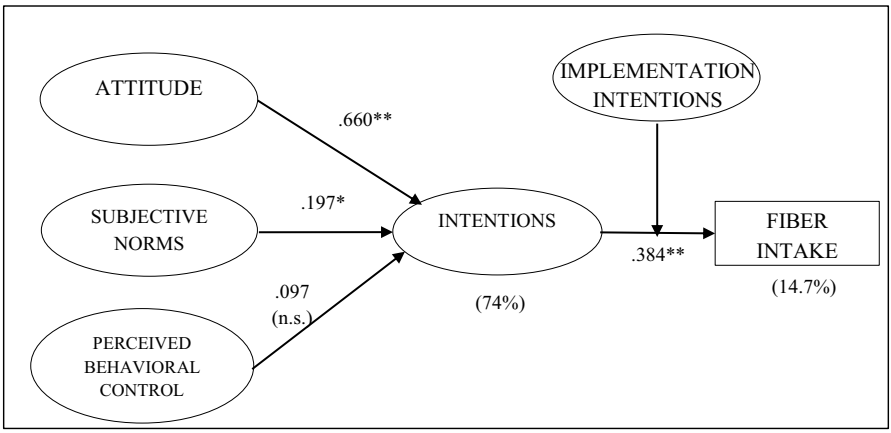
The structural model with the five constructs was estimated using maximum likelihood (see Figure 1). The structural equation model was evaluated by examining the absolute fit indices, incremental fit indices and parsimony fit indices. The basic

model with regard to fiber consumption fit the data well (GFI = .903; IFI = .954; PCFI = .763; RMSEA = .070).

To assess the predictive value of II with regard to fiber consumption, II was modelled as a moderating variable between intention and behavior and examined by means of multigroup analysis (see Figure 2). The extended model fit the data well (GFI = .835; IFI = .943; PCFI = .911; RMSEA = .050) and accounted for 14.7% of the variance in fiber consumption, whereas the previous model without the moderating effect of II accounted for 6.8%. Therefore, II doubled the explained variance in fiber intake, indicating the moderating effect of II in the process.

Additionally, to specifically identify whether potential differences existed in the estimates of the path from intention to behavior between the groups that formulated II and those that did not, the model was estimated across both subgroups (with and without II) simultaneously and unconstrained. The chi-square value for the unconstrained model was 321.1 with df = 196.

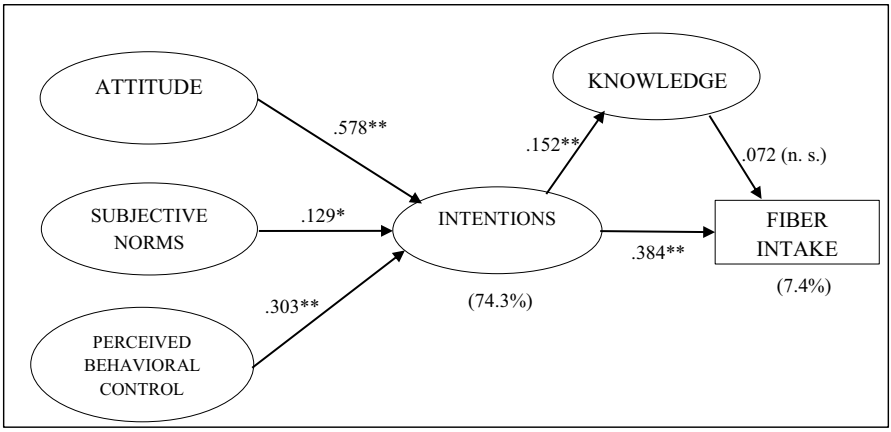
Next, the model was re-estimated across both groups by constraining the relationship to be analyzed (intention → behavior) (partially constrained model), which revealed a chi-square value of 324.6 with df = 197. Finally, the chi-square differ-



*$p < .10$; ** $p < .05$

Figure 2 Structural model estimates for II group

ence statistic in changing degrees of freedom was examined to identify invariance in the model fit between unconstrained and not completely constrained models (Byrne, 2004; Kline, 2005). The results revealed that differences in the path estimates



*$p < .10$; ** $p < .05$

Figure 3 Baseline model and mediating effect of *Knowledge*

between the group formulating II and the control group were significant at the 90% level ($p = .061$). This suggests that II can be considered a moderator factor: the group formulating II increased the fiber intake. All these analyses suggest that the formulation of II narrowed the intention-behavior gap.

Using the first baseline model, the mediating effect of *Knowledge* was tested (see Figure 3). The overall goodness of fit of the model was good (GFI = .902; IFI = .955; PCFI = .771; RMSEA = .065). All regression weights were significant, except in the relationship between knowledge and fiber intake ($p = .293$). Thus, the mediation of this variable was partial. It should also be noted that the inclusion of *Knowledge* slightly increased the explained variance of the model. Thus, H2b is partially supported.

4 Discussion

To our knowledge, this is the first study to test the effect of volitional interventions on raising fiber intake and to test whether educational information increases goal enactment in the context of difficult goals. Contrary to what was expected, this study found that the use of II did not significantly increase fiber intake, even when accompanied by educational information. Educational information successfully increased the knowledge of fiber-rich food but did not affect goal attainment. However, the use of II successfully narrowed the gap between intention and behavior. These results are puzzling because as mentioned in the introduction, fiber intake meets the conditions in which II are allegedly more effective.

There are two possible explanations for these results. First, participants may not have had perfect personal control over their plans (Dewitte et al., 2003): they may not have found the food they planned to consume in supermarkets, vending machines, or restaurants. Past studies have already pointed out the poor labelling

of food products in general (e. g. Andrews et al., 2014; Elshiewy & Boztug, 2018; Levy et al., 1994), of fiber-rich food in particular (Mobley et al., 2014), which may have prevented participants from completing their planned actions. Additionally, students usually eat out, which may explain why they did not have control over their plan. The reduced perceived behavioral control at follow-up is an indication of this perception of limited control ($M_{baseline} = 5.03$; $M_{follow\text{-}up} = 4.82$; $p = .004$). Likewise, fiber intake is not a public health issue: people are not conscious of its importance, and even health care specialists do not actively recommend increasing fiber intake (Clemens et al., 2012). This is linked to the concept of "food as well-being" presented by Block et al. (2011), where fiber may not be a health problem in the short term, but it is part of a more positive, holistic understanding of the role of food in overall well-being. This lack of awareness of fiber importance may create a non-supportive context for fiber intake, leading to few fiber-rich options in canteens, restaurants and vending machines.

II work because they raise the salience of the appropriate moments to act and because they automatize behavior by linking these situational cues with action. For fiber intake, these two mechanisms whereby II work may be jeopardized. First, the literature implicitly assumes that all courses of action are equally effective for goal attainment. This assumption is true for certain goals: if the goal is to eat five pieces of fruit or servings of vegetables per day, any serving will contribute to the goal attainment. However, this situation does not occur with fiber intake. Hence, participants may craft plans that raise the salience of the wrong course of action, which will not lead to goal attainment even if participants carry out their plans. This could explain why fiber intake was greater in the group receiving educational information and formulating II than in the other groups, although the difference was not statistically significant.

Additionally, previous studies have assumed that the context provides the cues that have been cognitively rehearsed. Imagine that the plan is "When I go to the canteen for lunch, I will have fruit for dessert". It is likely that the environment will provide a cue, as fruit is usually available for dessert. In contrast, if the plan is "When I go to the canteen for lunch, I will have whole-grain bread or whole-grain pasta", it is highly likely that it cannot be implemented. As mentioned earlier, evidence affirms that the environment is not that supportive of fiber intake (Clemens et al., 2012). Therefore, automatization may be jeopardized, as the context does not provide the expected cues. As Verplanken and Wood (2006) point out, for interventions targeted at changing consumers' habits, such as II, they will be most successful when paired with environmental changes that disrupt existing habits. If automatization is jeopardized, anticipatory decisions cannot be carried out, and the person must engage in *in situ* deliberations. This possible explanation, which should be tested in future studies, also suggests that a supportive environment is necessary to meet the recommended fiber intake goals.

Second, as other authors have noted in previous studies (Milne et al., 2002), there may have been conflicts with other healthy goals, such as a reduction in calories or fat intake: many fiber-rich products have a high caloric content (e.g., nuts and dried fruit) and thus may be perceived as "less healthy". Additionally, fiber-rich food could be perceived as less palatable than non-fiber-rich food.

It has been seen that the education intervention increases the knowledge of fiber-rich food. As it has been explained in the theoretical section, nutrition literacy had a stronger effect on the percentage of healthy food choices made than the intention to eat healthy (Buul et al., 2017). It was found that the effectiveness of II was dependent on the health literacy of participants (Ayre et al., 2019). However, in this experiment the fact of ensuring at least a minimum level of nutrition knowledge was not enough to increase fiber consumption. Explanations to this finding maybe similar to those previously offered. The context is not supportive to the goal of increasing fiber intake, there are not many options of fiber-rich food when eating outside home. Moreover, conflicting goals have to be taken into account. Increasing fiber intake may be in contradiction with other healthy goals such as reducing calories intake.

5 Conclusions

This paper showed that participants did not attain the recommended fiber quantities, even with goal intentions and goal plans based on sound knowledge about fiber-rich food. Whereas for fruit and vegetables, the "5 pieces a day" heuristic may have worked, for fiber, the "make half of your grains wholesale" heuristic is not yet effective in raising fiber intake (Mobley et al., 2014).

5.1 Limitations and suggestions for further research

Several limitations of this research have to be noted. First, the external validity of this study may be hampered by the sample size and the sampling method: in our sample, higher-educated and young people were overrepresented. Future studies should be conducted with different samples, including clinical populations, to increase the confidence in the external validity. Additionally, the sample was not representative of the population. This study included a high percentage of young students. Further research is therefore necessary to investigate whether the obtained results will also be the same in a wider sample population. Second, findings for actual food intake were based on self-report. However, it was controlled for several variables such as honesty and seriousness in filling the food intake forms. Third, it would be valuable to replicate this research over a longer period than two weeks because to create and maintain a new behavior takes a longer period of time. Finally, results on educational intervention are not conclusive. Some more research is needed to better understand this aspect.

5.2 Implications for Education, Training, and Practice

These conclusions can help health authorities, policy makers, nutritionists and practitioners, as well as firms, improve practices and activities in the healthy eating

domain through a joint strategy. Regarding health authorities and policy makers, these conclusions indicate that campaigns that aim to promote healthy eating can benefit from encouraging individuals to formulate II. These campaigns should give precise instructions about introducing fiber-rich food that is easily available in the local context (e.g. eat wholegrain bread for breakfast; choose dried fruit for a snack). If fiber-rich food is not available in the local context and correctly labelled, the formulation of II will not raise the fiber intake, as the two mechanisms whereby II work will be compromised.

Policy makers can create a more supportive environment for fiber intake by introducing fiber-rich food in canteens and restaurants managed by governmental organizations, such as school or university canteens. Also, nutritionists should be targeted to raise salience and awareness of the importance of fiber in a healthy diet. Nutritionists can, in turn, raise salience of fiber and provide adequate information to patients about fiber-rich food and suggest action plans to incorporate fiber-rich food into citizens' diet. To this aim, policy makers need also to ensure that fiber content is correctly labelled and displayed on packaging. Unless consumers find the correct information on packaging they will not be able to carry out their action plans.

Companies can also promote the consumption of fiber-rich products by supporting consumers' formulation of II. That is, firms can communicate the fiber content of food in a manner that is consistent with the formulation of II. Companies can help and induce consumers to formulate their own plans when giving information on packaging or through advertising, presenting examples of II. For instance, suggesting how consumption of a given product contributes to daily fiber intake would help individuals carry out their fiber intake goals. Moreover, companies could assist in II formulation by suggesting when and how a given fiber-rich food could be consumed.

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