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ORIGINAL ARTICLE

Integrating the theory of planned behavior and the self-determination theory to promote Mediterranean diet adherence: A randomized controlled trial

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Abstract

The Mediterranean diet (MD) is one of the healthiest and most sustainable food regimes. Nevertheless, MD diffusion is still limited, emphasizing the need to understand the psychosocial factors that could predict and promote its adoption. Starting from an integrated model of Theory of Planned Behavior (TPB) and Self-Determination Theory (SDT), the present randomized controlled trial investigated the effect of manipulating motivation (autonomous vs. controlled) on intention and MD adherence behavior. Participants included 726 Italian adults randomly allocated to one of three conditions: autonomous motivation manipulation, controlled motivation manipulation, and control group. TPB variables were measured immediately after manipulation (T1), while MD adherence was evaluated 2 weeks later (T2). Results from multivariate analyses of variance highlighted that participants in the autonomous motivation condition reported higher intention and a more favorable cognitive attitude than control group participants. However, no change in behavior was found. Moreover, a path analysis with mediation

effect showed that the impact of autonomous motivation condition versus control group on intention was mediated by cognitive attitude. Findings support the integration of TPB and SDT to encourage intention to adhere to the MD, also suggesting that prompting autonomous motivation may help to promote a greater diffusion of this healthy and sustainable dietary pattern.

KEYWORDS

adherence, autonomous motivation, Mediterranean diet, randomized controlled trial, self-determination theory, theory of planned behavior

INTRODUCTION

Adhering to the Mediterranean diet (MD) is associated with several health, sociocultural, economic, and environmental benefits (Abdullah et al., 2015; Martini, 2019; Phull et al., 2015; Trajkovska Petkoska & Trajkovska-Broach, 2021), which makes it one of the healthiest and most sustainable diet (Serra-Majem et al., 2020). MD dietary pattern is characterized by high consumption of plant-based foods (e.g. vegetables, fruit, legumes, and cereals) and moderate intake of milk and dairy products, fish, poultry, eggs, and wine. On the other hand, the consumption of red and processed meats, as well as saturated fats (e.g. butter), should be limited, preferring monounsaturated fats (e.g. olive oil) (Bach-Faig et al., 2011; Zaragoza-Martí et al., 2018).

Regarding MD impact on health, adopting this diet is associated with many long-term benefits, such as a lower death rate from cardiovascular and neoplastic diseases (Widmer et al., 2015). In addition, as adhering to the MD also means buying and consuming local and seasonal products to respect sustainability criteria (Bonofiglio, 2022), further advantages include the low environmental impact and biodiversity of the products and support for the local economy (Dernini et al., 2017). However, MD is not just a diet but can be defined as a real-life philosophy including cultural and lifestyle aspects, such as conviviality and culinary activities, the importance of doing regular physical activity, and the preference for foods expressing the tradition and culture of the places of production (Bach-Faig et al., 2011).

Despite the many benefits of MD, in recent years, in Italy, there has been a gradual abandonment of this diet in favor of less healthy eating behaviors (Italian Ministry of Health, 2020), making it necessary to understand which psychological factors underlie the choice to adhere to it and the planning of interventions aimed at promoting its diffusion.

Over the last 20 years, numerous psychological studies have investigated the possible determinants of healthy food choices, underlining the key role of psychosocial variables such as attitudes, beliefs, subjective norms, perception of control over one's behavior, motivation, and past behavior (Conner et al., 2002; McClain et al., 2009; Munt et al., 2017). However, in most cases, the research conducted in this area has exclusively explored the factors involved in the choice to consume (or avoid) very specific categories of foods, such as fruit and vegetables

(e.g. Caso et al., 2016; Guillaumie et al., 2010), red and processed meats (e.g. Carfora et al., 2020; Gaspar et al., 2016), and snacks or foods high in sugar and fat (the so-called "junk foods"; e.g. Caso et al., 2020; Vichayanrat et al., 2018). Net of the crucial contribution of this line of research, it has been shown that the long-term health benefits do not derive from the targeted consumption or avoidance of particular foods but from the synergy of all the components present in a complete and balanced diet, such as the Mediterranean one (Mari et al., 2007). The latter, despite being characterized by high flexibility in the selection of foods (Martínez-González et al., 2017), requires the regular intake of nutritionally balanced meals and their distribution over the day (breakfast, snacks, lunch, and dinner) and the week according to specific rules (Italian Ministry of Health, 2020). Despite this, few psychological studies in the literature have looked into the factors underlying the choice to follow the MD (e.g. Carfora et al., 2022; Mari et al., 2007; Ruggiero et al., 2019), and the majority is based on a cross-sectional design, not allowing to infer cause–effect relationships between the investigated variables. In addition, although there is evidence that theory-based interventions are the most effective for changing numerous healthy behaviors, including eating (Michie & Abraham, 2004; Tsorbatzoudis, 2005), there is a lack of studies founded on established theoretical frameworks for predicting and/or promoting the MD.

Thus, in order to fill the current research gap, we designed a randomized controlled trial (RCT) based on the integration of two theories whose effectiveness in terms of understanding and predicting healthy behaviors has been widely demonstrated: the Theory of Planned Behavior (TPB; Ajzen, 1991) and the Self-Determination Theory (SDT; Deci & Ryan, 2012). Specifically, we tested the effect of manipulating autonomous motivation—an SDT variable—on TPB variables (intention, attitude, subjective norms, and perceived behavioral control [PBC]) and MD adherence behavior.

Theoretical framework

TPB and SDT are two leading psychosocial theories used extensively to understand and predict health behaviors, as shown by independent meta-analyses (e.g. Armitage & Conner, 2001; Ng et al., 2012). TPB focuses on the socio-cognitive factors shaping intention and subsequent behavior, whereas SDT is a motivational theory examining human motives generated by their psychological need for self-determination (Fortier et al., 2009). As explained below, both theories have some limitations, which can make their integration particularly useful and sound.

Theory of Planned Behavior

According to the TPB, the most proximal predictor of behavior is an individual's intention to perform or not to perform it. In turn, intention is determined by three key variables: attitude, which is the overall favorable or unfavorable evaluation of the behavior, including both cognitive (e.g. healthy eating is beneficial and responsible) and affective (e.g. healthy eating is tasty and pleasant) components; subjective norms, which can be split into injunctive (perceived social pressure to perform or not the behavior) and descriptive (perception of what important others do regarding the behavior; Rivis & Sheeran, 2003) norms; and PBC, that is, the perception of being capable of performing and in control of the behavior. Intention is supposed to completely mediate the effects of such cognitions on actual behavior (Ajzen, 1991).

TPB has been effectively applied to the prediction of several eating behaviors, both healthy (e.g. fruit and vegetable consumption; Blanchard et al., 2009; Canova et al., 2020; Canova & Manganelli, 2016; Caso et al., 2016; Kothe & Mullan, 2015) and unhealthy (e.g. junk food or fast-food consumption; Dunn et al., 2011; Mirkarimi et al., 2016; Mougkridou & Protogerou, 2014; Sharifirad et al., 2013). Notably, while most of these studies rely on cross-sectional design or focus on intention rather than behavior, longitudinal (e.g. Chitsaz et al., 2017; Conner et al., 2002) and intervention studies (e.g. Capasso et al., 2020; Gratton et al., 2007) further demonstrated the long-term predictivity of TPB and the effectiveness of using it as a framework for the implementation of interventions aimed at promoting healthy eating behaviors. Nevertheless, despite the proven capacity of TPB to explain high proportions of variance in intentions and health-related behaviors, one of its main weaknesses lies in the failure to identify the factors from which the determinants of behavior originate (Chatzisarantis et al., 2007).

Self-Determination Theory

Unlike the TPB, SDT focuses precisely on elucidating how and why individuals engage in a target behavior, distinguishing two main types of motivation: autonomous and controlled.

Autonomous motivation reflects engagement in behaviors and activities perceived as originating from the self and satisfying personally relevant goals, allowing people to meet their need for *self-determination* (Deci & Ryan, 2012). Specifically, three types of motivation can fall into the broader definition of "autonomous": identification and integration, which are two forms of extrinsic motivation, and intrinsic motivation. Identification reflects the motivation to engage in a particular behavior evaluated as important by the individual (e.g. "I want to follow the Mediterranean diet because I personally believe it is the best thing for my health"). Integration is experienced when individuals engage in a behavior because they value it as an essential part of their self and in line with their values and goals (e.g. "I want to follow the Mediterranean diet because it is consistent with my life goals"). Ultimately, intrinsic motivation reflects the highest form of self-determined motivation, as it occurs when people choose to behave in a certain way only for the pleasure and satisfaction they can derive from it. However, it must be emphasized that intrinsic motivation is generally not evaluated in SDT studies focused on health behaviors because the latter are rarely perceived as rewarding or enjoyable per se (Levesque et al., 2007).

In contrast, controlled motivation expresses engagement in behaviors for reasons perceived as external to the self, thus representing a not self-determined form of motivation. Two forms of extrinsic motivation can be labeled as controlled: external regulation and introjected regulation. External regulation reflects the motivation to engage in behavior due to the pressure on the part of others and/or to receive their approval (e.g. "I want to follow the Mediterranean diet because I feel pressure from others to do so"). Finally, introjected regulation indicates the motivation to behave in a certain way to avoid negative feelings, such as guilt and shame (e.g. "I want to follow the Mediterranean diet because I would feel guilty or ashamed if I did not").

As well as TPB, SDT has also been widely applied in the domain of eating behaviors. More in detail, autonomous forms of motivation have been associated with fruit and vegetable intake (Dwyer et al., 2017; McSpadden et al., 2016), sustainable eating behaviors (Gauthier et al., 2022), and less disordered eating (Bégin et al., 2018). Additionally, not only does autonomous motivation promote engagement in a specific behavior, but it also prompts its maintenance over time, making SDT-based interventions particularly effective in the context of health behavior change programs (Ntoumanis et al., 2021), including those focused on eating.

Interestingly, in this regard, Leblanc et al. (2016) demonstrated the efficacy of a 12-week nutritional SDT-based intervention aimed at promoting the MD. Using the motivational interviewing approach, the scholars found that changes in self-determined motivation translated into greater MD adoption among middle-aged adults, supporting the idea that working on autonomous motivation can be helpful in promoting adherence to a healthy diet in its complexity, over and above specific categories of healthy foods. Yet, despite its effectiveness, SDT is also not free from shortcomings: for example, the lack of a clear explanation of the exact process by which motivation translates into intention and behavior (Hagger & Chatzisarantis, 2009).

THE PRESENT STUDY

To sum up, TPB and SDT offer complimentary descriptions of the process leading to a given behavior: TPB explains *what* influences the intention to implement behavior, and STD clarifies *why* people form certain intentions. Indeed, it has been proposed that motivational constructs from SDT can act as sources of information in the process of formation of the socio-cognitive constructs from TPB (Hagger et al., 2002). In other words, people's motivational orientations would shape their attitudes, subjective norms, and PBC, which in turn would predict intention and subsequent behavior. A meta-analysis by Hagger and Chatzisarantis (2009) of studies integrating TPB and SDT supported such theoretical integration, also confirming the motivational sequence from self-determined motivation constructs to TPB socio-cognitive variables. Nevertheless, we found only one study (Lirola et al., 2021) integrating these two frameworks to explore adherence to the MD, which confirmed the temporal sequence from SDT to TPB variables in the MD domain. However, it should be noted that participants were students aged 13–19; thus, the validity of this extended model has yet to be demonstrated in young adult and adult samples, which is one of the objectives of the present study. Finally, to our knowledge, no research has tested the effectiveness of manipulating motivation (autonomous vs. controlled) to change healthy eating cognitions and consequent intention and behavior. Indeed, demonstrating these relationships via an RCT design can form the basis for the design of structured and long-term interventions aimed at increasing adherence to the MD.

According to these premises, the present study aims to evaluate the efficacy of manipulating motivation (autonomous vs. controlled) to change intention and MD adherence. Specifically, our investigation focused on the following research questions:

Research Question 1. Do participants in condition 1 (autonomous motivation) report higher levels of autonomous motivation, intention, more favorable attitudes, higher subjective norms, and PBC compared with participants in other conditions?

Research Question 2. Do any changes in motivation due to manipulation persist at T2?

Research Question 3. Do these eventual changes translate, after 2 weeks, into greater adherence to the MD?

Research Question 4. Do TPB variables (i.e. attitudes, subjective norms, and PBC) mediate any effect of the autonomous or controlled condition on intention and MD adherence behavior?

METHOD

Participants and procedure

Using GPower 3.1, we estimated the required sample size for detecting a small-sized effect (Cohen's $f = 0.15$, based on the effect of SDT interventions on health behaviors at follow-up—as MD adherence behavior at T2 represented our main outcome—in Ntoumanis et al., 2021, Hedges's $g = 0.28$), with an alpha = .05, power = 0.80, and three conditions. The estimated sample size was $n = 432$ for the between-group comparison. Thus, we aimed to recruit at least 600 in order to achieve more than sufficient power, taking into account expected attrition across the two time points and minor variation in numbers per condition due to randomization.

In March 2022, 250 university students attending courses in Social Psychology at three Italian universities (University of Naples "Federico II", University of Padua, and Salesian University Institute of Venice) were invited to take part in a study aimed at evaluating the psychological factors influencing adherence to the MD. Students were asked to fill out personally and to have at least three adults complete an online self-report questionnaire created through the Qualtrics platform in exchange for one university credit. In order to be eligible to participate in this study, participants were required to be of legal age (age ≥ 18). As shown in the participant flow chart (Figure 1), among the contacted participants ($n = 1062$), 832 (Women = 55%; Mean age = 32.4, $SD = 15.3$, range = 18–63) filled out the first questionnaire (T1), after being informed of the anonymity of the data collection and giving informed consent. Two weeks later (T2), a total of 726 participants (Women = 55.6%; Mean age = 32.8, $SD = 15.4$, range = 18–63) completed the second questionnaire. Only those who completed both questionnaires were considered in the analyses.

Regarding the final sample characteristics, participants were almost equally distributed between students (51.4%) and nonstudents (48.6%). Most were omnivores (84.3%) and came from the Campania region (72.7%). Moreover, respondents reported a mean weight of 69.71 kg ($SD = 15.5$), a mean height of 170 cm ($SD = 9.47$), and declared an average family monthly income of 1001 to 3000 € (69.1%). As regards student participants, 35.4% came from the University of Naples "Federico II", 23.3% came from the Salesian University Institute of Venice, 14.7% came from the University of Padua, and the remaining 26.6% declared to attend different universities. As for nonstudents, 18.7% were employees, 17.6% housewives, 16.1% entrepreneurs or freelancers, 15.9% traders or workers/artisans, 8.8% teachers or educators, 5.7% unemployed, and 17.2% reported different occupations. This study was conducted following receipt of ethical approval by the Ethical Committee of Psychological Research of the Department of Humanities of the University of Naples "Federico II" (Protocol number 33/2021).

Study design

At T1, all participants completed a past behavior measure about adherence to the MD in the last 2 weeks and read some basic information on the characteristics of such a dietary pattern. Thereafter, they were randomly allocated to one of three conditions:

1. *Autonomous motivation* condition: Participants in this condition were exposed to a verbal stimulus, including a final question to be answered in a written form aimed at increasing their *autonomous motivation* to adhere to the MD;

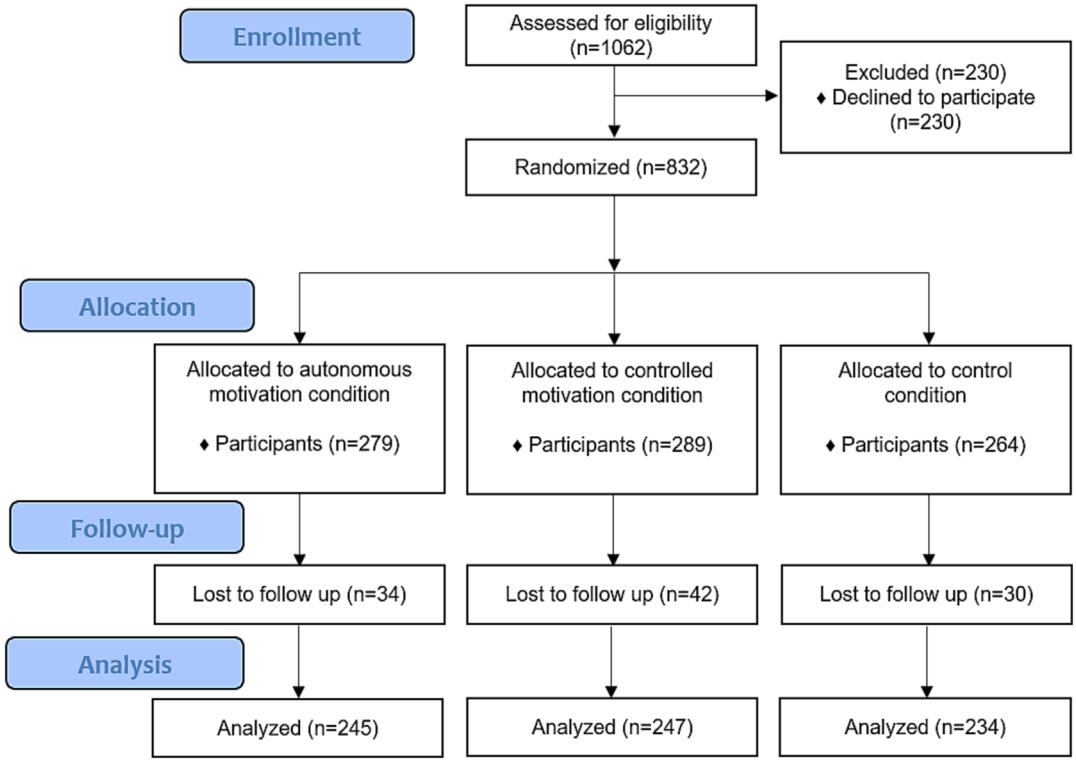

FIGURE 1 Participant flow chart.

2. *Controlled motivation* condition: Participants in this condition were exposed to a verbal stimulus, including a final question to be answered in a written form aimed at increasing their *controlled motivation* to adhere to the MD; and
3. *Control condition*: Participants in the control condition were not exposed to any verbal stimulus.

The verbal stimuli used in the autonomous and controlled conditions have been adapted from a previous work by Staunton et al. (2015), testing, within a 2 × 2 factorial design, the effects of manipulating perceived control and motivation on flossing behavior. We adapted one of the factors manipulated by the authors (increasing intrinsic motivation vs. increasing extrinsic motivation) to compare two forms of extrinsic motivation: autonomous and controlled ones. Verbal stimuli and specific behavior change techniques (Michie et al., 2013) used in each condition are displayed in Table 1.

After being exposed to stimuli (or directly after reading the basic information about the MD, in the case of the control group), participants completed SDT measures (autonomous and controlled motivation) and TPB measures (intention, cognitive and affective attitudes, injunctive and descriptive norms, and PBC).

At T2, after 2 weeks, participants completed a behavioral measure related to adherence to the MD during the last 2 weeks, along with a second measurement of SDT variables.

In both questionnaires, we required a mandatory answer to each item, so no respondents had missing values.

Measures

Demographic information was measured asking participants to indicate their age, gender, weight and height (in order to calculate their Body Mass Index [BMI]), dietary regime, education level and occupation (in the case of nonstudent participants), attended university and degree course (in the case of students), monthly family income, and geographical region of residence.

Adherence to the MD in the last 2 weeks was measured both at T1 (as a measure of past behavior) and at T2 (as a measure of actual behavior) using the MEDI-LITE score (Sofi et al., 2017). Such an instrument represents a novel MD adherence score, validated in the Italian context, considering nine food categories: fruit, vegetables, cereal grains, legumes, fish and fish products, meat and meat products, dairy products, alcohol intake, and olive oil. For each category, participants were asked to indicate, among three alternatives, the frequency of consumption, which could be low, moderate, or high. For the five categories relating to foods recommended in the MD regimen (fruit, vegetables, cereal grains, legumes, and fish), the scale provides that a score of 2 is assigned to the highest consumption category, a score of 1 to the intermediate one, and a score of 0 to the lowest one. The scoring is inverse, however, for the two categories relating to foods to avoid in the MD dietary pattern, that is, meat and dairy products. For the alcohol category, a score of 2 is assigned to the middle category of consumption, a score of 1 for the lowest one, and a score of 0 for the highest one. Finally, regarding the consumption of olive oil, a score of 2 is assigned to the highest category (regular use), a score of 1 to the intermediate one (frequent use), and 0 point to the lowest category (occasional use). The overall score, obtained by summing the scores to the nine categories, can range from 0 to 18, with higher scores indicating greater adherence to the MD.

Autonomous and controlled motivation were assessed by adapting the Treatment Self-Regulation Questionnaire (Levesque et al., 2007). Specifically, we measured two autonomous forms of extrinsic motivation (i.e. identification and integration; six items) and two controlled forms of extrinsic motivation (i.e. external and introjected regulations; six items). As indicated by the authors of the scale, who confirmed a four-factor structure of the Treatment Self-Regulation Questionnaire (i.e. autonomous motivation, introjected regulation, external regulation, and amotivation), we computed a single score for autonomous motivation, while we kept separate external and introjected regulations. Items were evaluated on a 5-point Likert scale ranging from *not at all true* (1) to *very true* (5). An example item for autonomous motivation was "I want to follow the Mediterranean diet because it is very important for being as healthy as possible." In contrast, an example item for controlled motivation was "I want to follow the Mediterranean diet because I want others to see I can do it." Cronbach's $\alpha = .79$ at T1 and .83 at T2 for [autonomous] identification; .81 at T1 and .85 at T2 for [autonomous] integration; .87 at T1 and .90 at T2 for autonomous motivation full score; .81 at T1 and .86 at T2 for [controlled] external regulation; and .52 at T1 and .62 at T2 for [controlled] introjected regulation.

TPB constructs (i.e. intention, cognitive attitude, affective attitude, injunctive norm, descriptive norm, and PBC) were assessed following Fishbein and Ajzen's (2010) guidelines, adapting items previously used in the Italian context (Canova & Manganelli, 2016; Caso et al., 2016).

Intention to adhere to the MD was measured by four items. The first three items (e.g. "I intend to follow the Mediterranean diet in the next two weeks") were evaluated on a 5-point Likert scale from *completely disagree* (1) to *completely agree* (5). The fourth item asked:

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TABLE 1 Verbal stimuli and behavior change techniques used in the autonomous and controlled conditions.

Condition	Verbal stimulus	Behavior change techniques
Autonomous motivation	In this study, we are interested in exploring the reasons why people might choose to follow a Mediterranean-type diet. The World Health Organization recommends educating people about the Mediterranean diet from school age, making them aware of its enormous benefits to health, economy, and environment. For example, a recent study demonstrated the health benefits of the Mediterranean diet, including the reduced risk of getting sick with cardiovascular disease and type 2 diabetes. Now, we ask you to take a few minutes of your time to reflect and answer the following questions: **Why might you be interested in following the Mediterranean diet? How could following the Mediterranean diet be in line with your values and what is important to you as a person?** Please enter your answer below.	Information about health consequences (5.1); salience of consequences (5.2); credible source (9.1); and valued self-identity (13.4)
Controlled motivation	In this study, we are interested in exploring the reasons why people might choose to follow a Mediterranean-type diet. The World Health Organization recommends educating people about the Mediterranean diet from school age, making them aware of its enormous benefits to health, economy, and environment. For example, a recent study demonstrated the health benefits of the Mediterranean diet, including the reduced risk of getting sick with cardiovascular disease and type 2 diabetes. Now, we ask you to take a few minutes of your time to reflect and answer the following questions. **In your opinion, why does the World Health Organization make this recommendation? Why does the World Health Organization emphasize the importance of following the Mediterranean diet?** Please list below what you think might be the main reasons.	Information about health consequences (5.1); salience of consequences (5.2); information about others approval (6.3); and credible source (9.1)

"How likely is your intention to follow the Mediterranean eating diet in the next two weeks?" The latter was rated on a 5-point scale ranging from *very unlikely* (1) to *very likely* (5). Cronbach's $\alpha = .91$.

Attitude toward adhering to the MD was assessed with nine 7-point semantic differential adjective scales ranging from 1 (*negative pole*) to 5 (*positive pole*). The first five scales assessed the cognitive component of attitude ("Following the Mediterranean diet in the next two weeks would be... *harmful/beneficial*, *useless/useful*, *dangerous/safe*, *irresponsible/responsible*, *stupid/intelligent*"), while the other four assessed the affective component ("Following the Mediterranean diet in the next two weeks would be... *agreeable/disagreeable, undesirable/desirable, unpleasant/pleasant, disgusting/tasty*"). Cronbach's $\alpha = .84$ for cognitive attitude and .91 for affective attitude.

Injunctive norm was assessed using three items on a Likert scale from *completely disagree* (1) to *completely agree* (5) (e.g. "Most people important to me think I should follow the Mediterranean diet in the next two weeks"). Cronbach's $\alpha = .88$.

Descriptive norm was assessed using three items. The first two items (e.g. "Most people important to me follow the Mediterranean diet") were evaluated on a Likert scale from *completely disagree* (1) to *completely agree* (5). The third item asked: "How many of the people who are important to you follow the Mediterranean diet?" Participants answered on a 5-point scale ranging from *nobody* (1) to *everyone* (5). Cronbach's $\alpha = .82$.

Perceived behavioral control was measured using three items. The first two items (e.g. "Following the Mediterranean diet in the next two weeks is entirely up to me") were evaluated on a 5-point Likert scale from *completely disagree* (1) to *completely agree* (5). The third item asked: "How easy or difficult do you think it is for you to follow the Mediterranean diet in the next two weeks?" Participants answered on a 5-point scale ranging from *very difficult* (1) to *very easy* (5). Cronbach's $\alpha = .73$.

ANALYSES

Analyses were conducted using SPSS 28 and MPLUS 8.6. To estimate the reliability, Cronbach's alpha coefficients were calculated. In preliminary analyses, we conducted multivariate analysis of variance (MANOVA) and Chi-squared test to check whether the sample was biased and the randomization was adequate. In the main analyses, we used MANOVA analyses to examine the differences between conditions regarding post-manipulation measures of autonomous, external, and introjected motivations both at T1 and T2. Finally, via MANOVA, we examined the differences between the three conditions on TPB constructs (at T1) and adherence to the MD (at T2). Post hoc comparisons (with Bonferroni tests) between each motivation condition and the control condition were conducted.

A path analysis (via MPLUS 8.6) was carried out to test whether the effects of motivation manipulation conditions on adherence to MD behavior were mediated via each TPB variable and then intention. The indirect effects were considered statistically significant if the bootstrapped 95% confidence intervals (CIs) did not include zero. Preliminary, to investigate the adequacy of the measurement model, we conducted confirmatory factor analysis using the maximum likelihood method applied to covariance matrices with MPLUS 8.6. The measurement models included seven latent factors and 23 indicators. Goodness of fit was evaluated by means of a set of conventional indices: χ^2, root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and standardized root mean square residual

(SRMR). Typically, a satisfactory model is denoted by χ^2 not being significant, RMSEA ≤ 0.06, CFI and TLI ≥ 0.95, and SRMR ≤ 0.08 (Hu & Bentler, 1999).

RESULTS

Preliminary analyses

To check whether randomization was successful, a MANOVA on past adherence to the MD, age, and BMI was applied. Results did not show any significant difference across the three conditions (multivariate main effect: $F_{6,1444} = 1.23$; $p = .29$, $\eta_p^2 = 0.01$). In addition, the Chi-squared test did not show significant differences across the conditions in relation to sociodemographic characteristics (gender, area of residence, educational level, students vs. nonstudents; in the case of university students, degree course attended; in the case of nonstudents, occupation) and dietary regime (all $p_s > .22$). Thus, these findings confirmed that randomization was adequate.

Additionally, attrition analysis, conducted via MANOVA, showed that age, BMI, past adherence to the MD, and our main dependent variables (autonomous and controlled motivation measures, intention, cognitive and affective attitudes, injunctive and descriptive norms, and PBC) at T1 were not significantly different between those who completed both questionnaires ($n = 726$) and those who dropped out ($n = 106$) (multivariate main effect: $F_{12,819} = 1.27$; $p = .23$, $\eta_p^2 = 0.02$). Regarding other sociodemographic variables, no significant difference was found (all $p_s > .18$) except for the university attended ($p < .01$). This would suggest that our final sample was acceptably representative of the initial sample.

Main analyses

We analyzed the differences between conditions in autonomous, external, and introjected motivations both in the case of the first wave (T1) and second wave (T2) (Table 2). For the first wave, MANOVA analysis pointed to a significant multivariate main effect ($F_{6,1444} = 6.70$, $p < .001$, $\eta_p^2 = 0.03$); the analysis of univariate effects showed a significant difference only for autonomous motivation. Post hoc comparisons between the three conditions (autonomous and controlled motivation manipulation and control group) showed that autonomous motivation was significantly higher ($p < .001$) in the autonomous motivation condition compared with the control group; autonomous motivation was significantly higher ($p < .001$) also in the controlled motivation manipulation condition compared with the control group.

In the second wave, MANOVA showed that the multivariate main effect was not significant ($F_{6,1444} = 2.08$, $p = .05$, $\eta_p^2 = 0.01$); however, the analysis of univariate effects showed a significant effect only for autonomous motivation. Post hoc comparisons between the three conditions indicated that, also in this case, autonomous motivation was significantly higher ($p < .02$) in the autonomous motivation condition compared with the control group.

Then, we considered the differences in the constructs of the TPB model (cognitive and affective attitudes, injunctive and descriptive norms, PBC, intention, and adherence to MD behavior) across the conditions (Table 2). For TPB constructs measured at T1, MANOVA analysis indicated that the multivariate main effect was not significant ($F_{12,1438} = 1.23$, $p = .26$, $\eta_p^2 = 0.01$); however, the analysis of univariate effects showed significant differences for cognitive attitude

TABLE 2 Descriptive and inferential statistics of motivation measures and Theory of Planned Behavior constructs in each condition at T1 and T2.

	Condition	*M* (*SD*)	Univariate $F_{2,723}$	Partial η^2	Sig. pairwise comparisons
First wave measures (T1)					
Autonomous motivation	1	4.14 (0.69)	20.05***	0.05	Condition 1 > condition 3*** and condition 2 > condition 3***
	2	4.05 (0.68)			
	3	3.74 (0.81)			
Introject motivation	1	2.35 (0.95)	2.27	0.01	—
	2	2.25 (0.93)			
	3	2.17 (0.97)			
External motivation	1	1.49 (0.71)	0.20	0.00	—
	2	1.51 (0.73)			
	3	1.53 (0.75)			
Cognitive attitude	1	6.15 (0.80)	3.95*	0.01	Condition 1 > condition 3* and condition 2 > condition 3*
	2	6.14 (0.87)			
	3	5.96 (0.86)			
Affective attitude	1	5.82 (0.94)	2.20	0.01	—
	2	5.70 (1.07)			
	3	5.63 (0.99)			
Injunctive norm	1	2.83 (1.06)	1.09	0.00	—
	2	2.92 (1.05)			
	3	2.78 (1.07)			
Descriptive norm	1	3.23 (0.86)	1.12	0.00	—
	2	3.23 (0.81)			
	3	3.13 (0.80)			
Perceived behavioral control	1	3.65 (0.79)	0.26	0.00	—
	2	3.63 (0.79)			
	3	3.60 (0.80)			
Intention	1	3.70 (0.89)	3.73*	0.01	Condition 1 > condition 3*
	2	3.64 (0.90)			
	3	3.48 (0.98)			
Second wave measures (T2)					
Autonomous motivation	1	3.93 (0.84)	4.25*	0.01	Condition 1 > condition 3*
	2	3.89 (0.81)			
	3	3.72 (0.82)			
Introject motivation	1	2.39 (0.96)	0.49	0.00	—
	2	2.32 (1.07)			
	3	2.40 (1.00)			

TABLE 2 (Continued)

	Condition	*M* (*SD*)	Univariate $F_{2,723}$	Partial η^2	Sig. pairwise comparisons
External motivation	1	1.71 (0.85)	0.24	0.00	—
	2	1.67 (0.87)			
	3	1.72 (0.89)			
Adherence behavior	1	9.31 (2.36)	1.59	0.00	—
	2	9.13 (2.06)			
	3	9.49 (2.24)			

Note: Condition 1 = autonomous motivation manipulation; Condition 2 = controlled motivation manipulation; and Condition 3 = control condition.
*$p < .05$, **$p < .01$, and ***$p < .001$.

and intention. Post hoc comparisons between the three conditions showed that cognitive attitude toward adhering to the MD was significantly more favorable ($p < .05$) in the autonomous motivation condition and in the controlled condition compared with the control group; intention was also significantly more positive ($p < .05$) in the autonomous motivation condition compared with the control group.

As for the adherence to MD behavior at T2, the analysis of variance showed that the effect of the condition was not significant.

Path analysis

To answer to Research Question 4, we tested, via path analysis, whether the effect of autonomous motivation manipulation (code = 1) versus control group (code = 0) on intention and behavior was mediated via TPB constructs (Figure 2). The analysis was conducted controlling for gender (code 0 = men, code 1 = women), age, BMI, and past adherence to the MD ($n = 474$). We chose to compare only the condition 1 group with the control group because, according to the results described above, autonomous motivation manipulation was the only one that affected the autonomous motivation itself, cognitive attitude, and intention. Moreover, the effect of the manipulation on autonomous motivation was maintained in the second wave (T2), 2 weeks later.

A preliminary analysis of the adequacy of the measurement model was conducted. Confirmatory factor analysis indicated that the seven factors model showed satisfactory goodness-of-fit indices: $\chi^2_{(210)} = 412.98$, $p < .001$, RMSEA = 0.05, 90% CI [0.04, 0.05], CFI = 0.97, TLI = 0.96, SRMR = 0.04. The correlations among the latent factors were all significant (except for the case of injunctive norm and PBC) but were < .80, thus excluding serious multicollinearity concerns (Kline, 2005) (Table 3).

The overall goodness of fit of the path analysis model was acceptable: $\chi^2_{(4)} = 9.66$, $p = .05$, RMSEA = 0.05 [90% CI: 0.01, 0.10], CFI = 0.99, TLI = 0.95, SRMR = 0.01. As expected, condition 1 versus control condition was associated with cognitive attitude (Figure 2). Moreover, past adherence to the MD was positively associated with cognitive attitude, descriptive norm, PBC, intention, and adherence to the MD at T2. Gender, BMI, and age were significantly associated with some TPB constructs; in particular, women declared a more favorable affective attitude

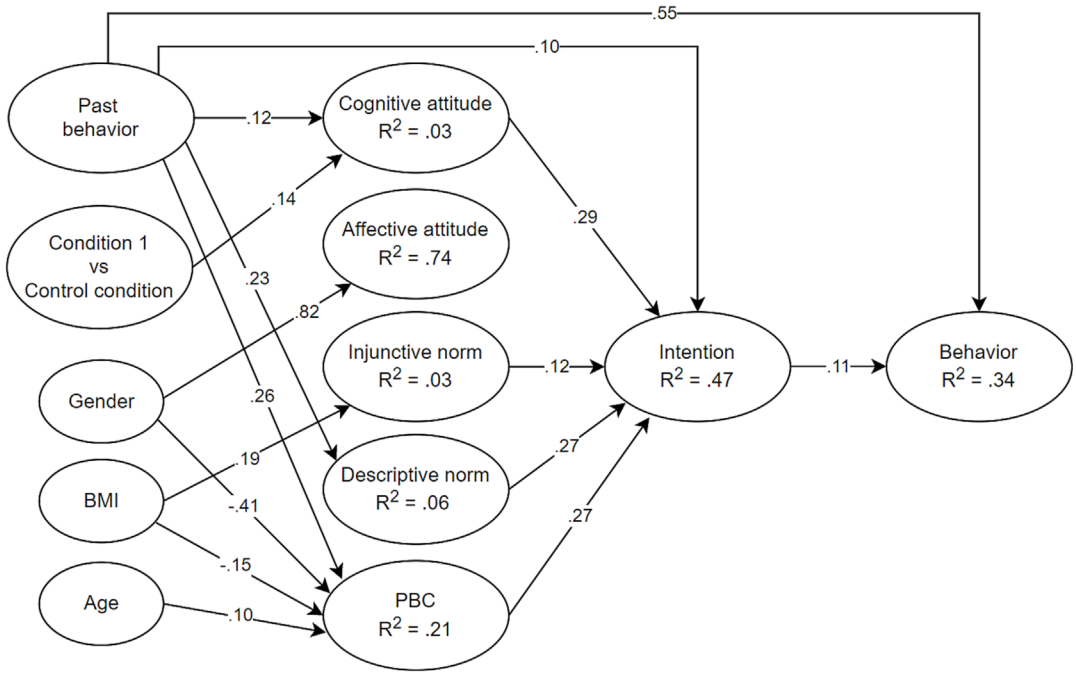

FIGURE 2 Standardized path coefficients ($N = 474$). Gender: 0 = Male, 1 = Female. Condition: 1 = autonomous motivation condition, 0 = control condition. Only significant paths are reported. BMI, Body Mass Index; PBC, perceived behavioral control.

TABLE 3 Correlations between latent factors ($N = 479$).

Constructs	1.	2.	3.	4.	5.	6.	7.
1. Cognitive attitude	—						
2. Affective attitude	.64 (0.03)	—					
3. Injunctive norm	.35 (0.05)	.15 (0.05)	—				
4. Descriptive norm	.25 (0.05)	.44 (0.04)	.41 (0.05)	—			
5. Perceived behavioral control	.24 (0.05)	.53 (0.04)	.05 (0.05)*	.52 (0.04)	—		
6. Intention	.51 (0.04)	.59 (0.03)	.36 (0.04)	.57 (0.04)	.52 (0.04)	—	
7. Adherence behavior	.23 (0.11)	.35 (0.11)	.28 (0.11)	.51 (0.11)	.46 (0.11)	.56 (0.11)	—

Note: Standard errors in parentheses. All coefficients are significant with $p < .05$, except the one denoted by *, for which $p > .34$.

toward adhering to the MD than men; older people and males perceived more control in following this dietary regime; people with higher BMI perceived stronger social pressure to follow the MD, but they considered more difficult to follow this diet. Intention was positively predicted by cognitive attitude, injunctive and descriptive norms, PBC, and past adherence to the MD. Finally, adherence to MD behavior at T2 was predicted by intention and past adherence to the same diet. Notably, past adherence to the MD had the strongest effect on adherence to the same diet at T2. Overall, the model accounted for 47% of the variance in intention and 34% of the variance in adherence to MD behavior.

The analysis of the indirect effects showed that only the standardized indirect effect of autonomous motivation condition on intention, via the mediation of cognitive attitude, was significant (*indirect effect* = 0.04, $p < .05$, 95% CI [0.01, 0.08]) and that cognitive attitude totally mediated the effect of condition 1 versus control on intention. The sequential mediation chain from manipulation condition to adherence to the MD at T2, via cognitive attitude and intention, was not significant (*indirect effect* = 0.004, $p < .12$, 95% CI [0.00, 0.01]).

In conclusion, the TPB model was supported, apart from the no significant effect of affective attitude on intention, and the manipulation of autonomous motivation indirectly affected, with the mediation of cognitive attitude, the intention, but not the adherence to MD behavior at T2.

DISCUSSION AND CONCLUSION

Despite its numerous advantages, MD is still under-diffused in Italy, especially in younger age groups (La Fauci et al., 2020). Although several studies (Michie & Abraham, 2004; Tsorbatzoudis, 2005) have demonstrated the effectiveness of theory-based interventions in changing specific eating behaviors (e.g. fruit and vegetable consumption), there is a dearth of research focused on promoting the adoption of a healthy regime in its entirety, such as the Mediterranean one. The present RCT aimed to fill this gap in the literature by testing the effect of manipulating motivation (autonomous vs. controlled) in increasing intention to adhere to the MD and the subsequent behavior.

We first tested whether participants in condition 1 (autonomous motivation) would have reported higher levels of autonomous motivation and TPB variables (intention, attitudes, subjective norms, and PBC) compared with participants in other conditions (Research Question 1) and whether any changes in motivation due to manipulation would have persisted at T2 (Research Question 2). Our findings showed that participants in the autonomous motivation condition reported higher autonomous motivation (both at T1 and T2), intention, and more favorable cognitive attitude toward adhering to the MD than those in the control group. This result corroborates past studies proving that autonomous forms of motivation promote changes in attitude and intention to adopt healthy eating behaviors (Jacobs et al., 2011), including adherence to the MD (Leblanc et al., 2016). Participants in the controlled motivation condition reported only a more favorable cognitive attitude compared with the control condition. This result is in line with the meta-analysis in the health domain by Ntoumanis et al. (2021), which found that the effects of SDT-based interventions on controlled motivation and amotivation were small and nonsignificant. Therefore, our findings confirm that when people's motives to follow the Mediterranean regime are self-determined, that is, when they feel that doing it fulfills important personal goals (e.g. maintaining good health) that originate from the self (e.g. from the perception of being health conscious), they are more likely to develop a positive attitude toward such a dietary pattern, recognizing that adhering to it is beneficial, useful, and responsible, and consequently to form stronger intentions to do so. While the relationship between autonomous motivation and healthy intentions is not new in the literature, our results are still novel as they indicate not only that this type of motivation is positively associated with intentions and attitudes in the MD domain but, above all, that manipulating autonomous motivation through a brief intervention can *change* these cognitions. Interestingly, such findings align with a recent intervention study (Hoffman et al., 2023), which showed that using self-persuasion—that is, stimulating people to generate their own motivations for adopting a

certain behavior—is an effective way to increase autonomous motivation and dietary intention. Noteworthily, our results extend those of Hoffman et al. (2023), demonstrating that a similar type of intervention can promote not only generic healthy eating intentions but also those associated with adherence to the Mediterranean regime.

However, it should be noted that the other evaluated TPB variables (i.e. affective attitude, injunctive and descriptive norms, and PBC) were not affected by the manipulation of autonomous motivation. This result is not particularly surprising considering that the proposed stimulus was primarily intended to make participants reflect on why adhering to the MD could have been *important* for them, in other words, on the reasons for which they could have positively evaluated the behavior in question mainly from a cognitive point of view; thus, it did not stress the possibility that adopting this behavior could have been pleasant nor the potential pressure of significant others or the ease of following this eating style.

Unexpectedly, participants in the controlled motivation condition also reported higher levels of autonomous motivation than those in the control group—although these changes have not persisted at T2—but did not show a shift in the levels of controlled motivation nor the other TPB variables. This result could have some potential explanations. First, the stimulus used in condition 2, while incentivizing to reflect on the external regulation to adhere to the MD (i.e. because the World Health Organization [WHO] recommends it), did not directly elicit negative feelings (e.g. shame or guilt) that the person could have experienced if they had chosen not to, as expected from the introjected regulation. The stimulus used may have prompted participants to still dwell on why following the Mediterranean regime might be important for them, even though the stimulus that triggered this reflection explicitly emphasized the role of an external source, that is, the WHO. Second, it is possible to speculate that the potential pressure perceived by the WHO (on which the text focused) may not be as relevant as that coming from significant others and, therefore, not particularly strong to activate and/or incentivize a controlled motivation to follow the MD. However, the effect of condition 2 on autonomous motivation may have been circumstantial because only the exposure to the stimulus used in condition 1—explicitly prompting participants to reflect on why adhering to the MD may be important for them *and* in line with their values—was able to produce an increase in autonomous motivation that has been maintained over time. Thus, to better isolate the effects of manipulating autonomous (vs. controlled) motivation on MD adherence, future studies could use controlled motivation cues that are more clearly focused both on the need to adopt the recommended behavior to avoid negative feelings (making salient the introjected regulation) and the pressure of significant others (prompting the external regulation).

In addition to motivation and TPB variables, we also evaluated whether manipulation would have impacted MD adherence behavior (Research Question 3), finding no statistically significant results. Given the habitual nature of eating behavior (Conner et al., 2002), it would have been unrealistic to expect substantial changes, above all considering that the intervention lasted only 2 weeks and that we aimed to change not a single behavior but a *pattern* of eating behaviors. In fact, it is possible to speculate that changing the entire diet (vs. single behavior) requires more time and effort. Despite this, the results obtained still appear encouraging. If prompting people to reflect briefly on their motivations can be sufficient to influence their intentions and attitudes positively, it is reasonable to expect that a more structured and longer lasting motivation-based intervention could also impact adherence behavior. However, in addition to considering the duration and level of structuring of the intervention, future studies should also take into account not only motivational components but also volitional processes. This is important in order to enhance the effectiveness of interventions, as literature has

extensively shown that volitional variables (e.g. planning) can play a crucial role in bridging the so-called "intention-behavior gap" (Caso et al., 2021).

Finally, we tested whether TPB variables (i.e. attitudes, subjective norms, and PBC) would have mediated any effect of the autonomous or controlled conditions on intention and MD adherence behavior (Research Question 4). In this regard, results showed that the only significant result was the one concerning the mediated path of autonomous motivation condition on intention via cognitive attitude. Participants who, based on the verbal stimulus, had elaborated and written the reasons why they would be interested in following the MD and how it would be in line with their values and important for them had developed a stronger intention to follow this type of diet through the formation of a more favorable cognitive evaluation. In other words, the manipulation of autonomous motivation led the respondents to evaluate the behavior as more beneficial, useful, safe, responsible, and intelligent and to develop a greater intention to perform it. Path analysis results confirmed that past behavior plays a crucial role in forming the intention to pursue this healthy eating behavior and its actual implementation. Thus, current results provide further support for using integrated theoretical models to test key predictors of health behaviors in intervention-based research. In this regard, Chan et al. (2020) emphasize that combining different theoretical approaches can more effectively predict health-related behaviors, as it can help to overcome the limitations and constraints of individual theories, ultimately leading to comprehensive explanations of behavior that are both comprehensive and concise.

Finally, as highlighted by van't Riet et al. (2011), when established (undesirable) eating patterns already exist, intervention studies, to be effective, should incorporate specific techniques to disrupt the unhealthy pattern under investigation, such as helping people inhibit their typical response by fostering their self-control abilities or working on the situation triggering the habitual behavior. Therefore, a promising avenue for future research would be to incorporate such techniques in MD promotion interventions based on autonomous motivation, in order to facilitate the translation of intention into actual behavior.

Some limitations of these studies must be mentioned. First, the samples recruited were not representative of the Italian population. Second, all data were derived from self-report measures, which can be affected by social desirability bias, even if granting anonymity during data collection usually helps to counterbalance this weakness. Finally, as for condition 2, it is worth noting that the way we formulated the verbal stimulus could not have adequately addressed all the facets of controlled motivation because we did not make an explicit reference to the existence of pressure on the part of WHO to adopt the target behavior but rather suggested it indirectly.

Despite these limitations, the results of the present study emphasize the key role of autonomous motivation in healthy eating intention. To our knowledge, the present study is the first to have tested the effect of manipulating motivation (autonomous vs. controlled) on intention and MD adherence behavior. Moreover, the findings suggest the need to consider the role of cognitive attitude in intervention design.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

Questionnaires and data are available on request to the corresponding author.

ETHICS STATEMENT

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Ethical Committee of Psychological Research of the Department of Humanities of the University of Naples Federico II and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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