
Article

Online Fake News About Food: Self-Evaluation, Social Influence And The Stages Of Change Moderation

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Abstract: In the Italian context, the diffusion of online fake news about food is becoming increasingly fast-paced and widespread, making it more difficult for the public to recognize reliable information. Moreover, this phenomenon is deteriorating the relation with public institutions and industries. The purpose of this article is to provide a more advanced understanding of the individual psychological factors and the social influence contribute to the belief in food-related online fake news and the aspects that can increase or mitigate this risk. Data were collected with a self-report questionnaire between February and March 2019. We obtained 1004 valid questionnaires filled out by a representative sample of Italian population, extracted by stratified sampling. We used structural equation modelling (SEM) and the multi-group analyses to test our hypothesis. The results show that self-evaluation negatively affects the social-influence, which in turn positively affects the belief in online fake news. Moreover, this latter relationship is moderated by the readiness to change. Our results suggest that individual psychological characteristics and social influence are important to explain the belief in online fake news in the food sector; however, a pivotal role is played by the motivation of change lifestyle. This should be considered to engage people in clear and effective communication.

Keywords: Online Fake News; Interpersonal influence; Self-evaluation; Motivation for Change; Food Consumption.

1. Introduction

Online food and nutrition information seeking is a widespread and growing phenomenon. Collecting information on vitamins, diet, nutrition, and supplement information are the main motivations that lead people to use the internet and social media [1]. However, the Internet is not always a reliable source for information on diets and food choices. In fact, individuals are exposed to a variety of dietary and food (mis)information and lifestyle advice that may be contradictory and deviant with respect to health standards, encouraging "unhealthy behaviour" [2–4]. For these reasons, it appears urgent to understand the factors behind believing in online food fake news to engage people in a more aware search for information and better food choices. The scenario appears particularly critical in Italy, where the believing in online fake news is creating confusion among the population. Traditionally known as the standard-bearer of the Mediterranean diet, widely recognized as healthy, in latest years Italy is living a change in people's food choices that risks to move them away from proper dietary standards [5]. In fact, the presence of misinformation in the food sector determines the creation of negative atti-

tudes and opinions towards certain types of food (as happened for example for dairy or gluten consumption), which impact on purchase intentions and consequently can determine a permanent change in daily food habits. In order to limit this dangerous phenomenon, scholars have tried to understand what factors could contribute to the spread and belief in online fake news, and - consequently - to change people's food choices [6,7]. In particular, many scholars have studied the role of individual psychological and social factors in determining believing in fake news [8]. However, these variables seem not enough to explain a change in behaviours due to misinformation. To propose a more complex explanation of this phenomenon, we introduce the motivation to change as a possible pivotal variable. From the literature, indeed, it is known that people in different stages of change could be more or less inclined to change their behaviours towards better food choices [9], which include appropriate search for information [10]. However, up to date, the motivation to change theory has not been used to study the phenomenon of fake news. To fill these knowledge gaps, this study aimed at exploring the role of motivation to change in the believing of food fake news to glimpse possible strategies to engage the people in adequate food choices.

2. Background and Hypothesis development

Studying the phenomenon of online fake news in the food sector is certainly complicated because it requires the consideration of different structural, individual and social factors, and it may be influenced by the specific life moment the individual is experiencing in relation to his own lifestyle. It has been demonstrated that individual psychological and social factors are more relevant in explaining this behaviour more than structural elements, such as the time spent using social media [6]. In particular, some studies demonstrated that when people have low self-esteem and a negative perception of self-concept, they seek confirmation of their behaviour in others, becoming more susceptible to interpersonal influence [11,12]. Moreover, people who are more predisposed to interpersonal influence are also more likely to believe and share the information given by others even if the information is false because this allows them to increase their social affirmation and improve their self-esteem [13]. From these premises, it is assumable that the interpersonal influence could mediate the relationships between self-evaluation and the believing in fake news. In support of this assumption, some studies affirm that it is not the level of self-esteem that directly determine the persuasive power of fake news but it is the necessity to improve self-perception that leads people to become more prone to follow the opinions and advice of others (interpersonal influence) in order to find a social consensus [14]. Moreover, as suggested by Transtheoretical Model of Prochaska and Di Clemente (1982) the search for information plays a different role according to the stage of change in which the person is. In particular, this model it is composed by five incremental stages of change in individuals' behaviours and lifestyle (i.e. precontemplation, contemplation, preparation, actions, maintenance) that allow identifying different phases of lifestyle change. In particular, according to this theory, during the preparation and actions stages, individuals need to consult and interact with external information sources (such as friends, relatives, blogs, forums, etc.) in order to be motivated to continue the change process and maintain it over time. Applying this model on lifestyle change, Liang and Scammon (2016) discovered how people modify their openness to external information and the way of seeking and using information based on specific life moment that the individual is experiencing in relation to his own lifestyle. Specifically, this research discovered that people who are in a stage of changing their lifestyle (preparation and action stages) are more predisposed to being socially influenced by external sources and in particular this orientation led them to believe more in online news (even if false) than those who are not in these stages. These results pointed out how the belief in online fake news could be amplified by the motivation of change lifestyle.

From these premises, we assume that:

H1: positive self-evaluation has a negative impact on the propensity to interpersonal influence

H2: the propensity to interpersonal influence positively influences the belief in online fake news

H3: the study assumes that the effect of the self-evaluation on the belief in online fake news is mediated, at least partially, by the interpersonal influence.

H4: the stage of change in one own diet can moderate the relationship between interpersonal influence and belief in online fake news.

Based on the aforementioned discussion, we can synthesize the hypothesis which inspired this study in the model depicted in Figure 1.

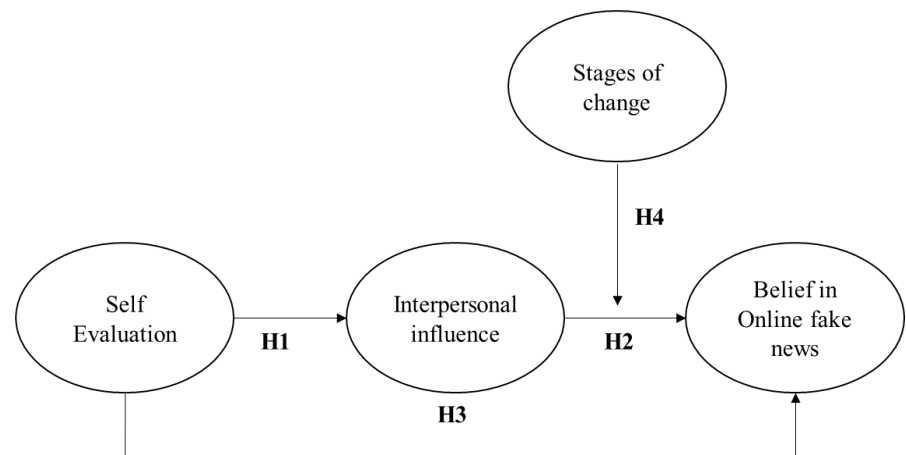


Figure 1. the hypothesized model

3. Materials and Methods

3.1 Procedure and sample

Data were collected via an online self-administered structured questionnaire on a sample of 1004 Italians, aged 18-75 years old, representative by sex, age, profession, size of the centre and geographical area, extracted by means of stratified sampling. The survey was conducted using a CAWI (Computer Assisted Web Interviewing) methodology in the first three weeks of March 2019. This study has been performed in accordance with the Declaration of Helsinki and has been approved by an independent ethics committee of Università Cattolica del Sacro Cuore in Milan (CERPS). All participants provided informed consent at the beginning of the questionnaire. Those who did not provide it were excluded from the database.

3.2 Measures

The structure self-administered questionnaire included both the following validated psychometric scales and ad hoc items (see supplementary materials):

- Core Self Evaluation Scale (CSES): we used the validation of Italian scale [17] which is composed of 12 items derived from the translation of Core Self-Evaluation Scale [18]. This Italian version of CSES has satisfactory reliability and validity with an $\alpha = 0.84$.

All items were assessed on 5-point Likert scales ranging from 1 ("completely disagree") to 5 ("completely agree"). An example of item is: "When I make plans, I am certain I can make them work".

- Susceptibility to interpersonal influence: the scale is scientifically validated [19] and is composed of 12 items used to measure the personal predisposition to the social influence. From this scale, four items were selected. In this study, the Cronbach's alpha coefficients for the scale were 0.83. All items are measured on 7-point Likert scales ranging

from 1 (“completely disagree”) to 7 (“completely agree”). An example of item is: “If I have little experience with a product, I often ask my friends about the product”.

- Belief in Online Fake News: this behaviour was assessed by an ad hoc item to explore the self-reported experience of believing in fake news occurred in the last year. The item adopted a five-point category scale from “never” to “always”. The single-item used is: “In the last year have you believed in a piece of news about food read on the Internet or on social networks that turned out to be a fake news (Fake News)?”.
- Stages of change: we based this measure on the Transtheoretical Model (TTM). In this model, five distinct motivational stages are identified (Prochaska & Velicer, 1997). This model was previously used in the Italian context on different health changes [21]. The items described here were created ad hoc on the basis of these five stages, one for each. Respondents decided to position their answer on the item that better represent their condition among the five. The item used is “How interested are you in making your lifestyle healthier than it is now?”

3.3 Data analysis

Descriptive statistics were computed for each item (asymmetry, kurtosis, mean, median, and standard deviation), and normality of distribution was checked.

As suggested by Anderson and Gerbing (1988) in order to check the adequacy of the measurement model a confirmatory factor analysis (CFA) was run using MPLUS 8. The models were estimated using maximum likelihood estimation (ML) and evaluated using the chi-square (i.e. non-significant values associated with p indicate a good model) and approximate fit statistics, based on Hu and Bentler (1999). These included: Root Mean Square Error of Approximation (RMSEA) < 0.08; Confirmatory Fit Index (CFI) ≥ 0.95 ; and Tucker-Lewis Index (TLI) ≥ 0.95 .

Moreover, structural equation modelling (SEM) was used to analyse the relationships between the self-evaluation and Interpersonal influence on the belief in online fake news. In particular, the bootstrap technique [24] was used in order to confirm the mediation hypothesis (the indirect relationship between an independent variable and the dependent variable considering the presence of the mediator) with more statistical rigour than the Sobel test [25,26]. The Percentile bootstrapping was performed at a 95% confidence interval with 5000 bootstrap samples [27].

To explore the moderating effect of stages of change invariance tests of the measurement model and structural model were conducted, following the suggested procedures used in Liu et al. (2015) research. Before the metric invariance test, the sample was divided in two sub-sample: in change group (n=646) which is composed of people who have responded that they intend to change their lifestyle within the next six months, in the immediate future or who have already changed their lifestyle; and not in change group (n=358), considering those who responded that they have no intention of changing their lifestyle or that their lifestyles are already healthy. Then the equality between the factor loadings of both groups (measurement invariance) was performed. First, CFA was employed for both groups without fixed factor loadings (configural invariance model); while another CFA was conducted for both groups with fixed factor loadings (metric invariance model). Then, the two different models were compared. After that, we use the SEM in order to compare two different models (unconstrained model) and the nested model (constrained model), where in the first model all the parameters were considered free and in the second one the path coefficient between the social influence and the belief in fake news was constrained in the two groups (in change, not in change). Through this comparison, we can identify the X^2 difference between the constrained model and the unconstrained one and if the X^2 difference is significant, the moderating effect of stages of change exists.

4. Results

4.1 Characteristics of the sample

The sample is made up of 1004 Italian respondents of which 497 are male and 507 are female with an age between 18 and 75 years with an average of 46 years and a standard deviation of ± 15.5 . The demographic profile is presented in detail in Table 1.

	n	%
1. Gender		
Male	497	49.5
Female	507	50.5
2. Age		
18-25	117	11.7
26-35	149	14.9
36-45	198	19.7
46-55	218	21.7
56-65	233	23.2
66-75	88	8.8
3. Education		
Low education level	136	13.5
Senior high	561	55.9
College or university	307	30.6
4. Main household food purchaser		
Yes, just me	527	52.5
Yes, with others	451	44.9
No	26	2.6
5. Income level		
Until 600 €	40	4
601-900 €	54	5.4
901-1200 €	95	9.5
1201-1500 €	148	14.8
1501-1800 €	129	12.8
1801-2550 €	179	17.8
2551-3550 €	146	14.6
More than 3550 €	83	8.3
Missing	130	12.9
6. Profession		
Employed	663	66
Unemployed/retired	341	34
7. Inhabited centre size		
Until 10000 inhabitants	478	47.6
10/30.000 inhabitants	140	14
30/100.000 inhabitants	149	14.8
More than 100.000	230	22.9
Missing	8	0.8
8. Geographic area		

North-West	261	26
North-East	190	18.9
Centre	199	19.8
South and Islands	354	35.3

4.2 The Measurement model

Means, standard deviations, medians, asymmetry and kurtosis of all the scales and items ad hoc used in this study were carried out, showing that all distributions appear normal (the Kurtosis ranges from -0.69 to 0.86 and the Asymmetry ranges from -0.72 to 0.62).

Moreover, confirmatory factor analysis (CFA) was applied to understand whether the data confirmed the assumption that these latent variables represent two separated constructs, validating the measurement model. For this purpose, the ML method was used. In order to control for inflated measurement errors, caused by multiple items that compose the self-evaluation latent variable, and to obtain more stable estimates and higher reliability, the use of parcels it is recommended [29–31]. A large number of studies used the method of parcel in order to include scales with many items in factor analysis and SEM [32] and, in particular, this method was also used to test the self-evaluation construct [33,34]. Although item parcels have been criticized for the absence of meaning and misspecification possibilities [35], Matsunaga (2008, p. 290) argue that the correct use of the parcel depends on the purpose of the study: "When the focus of the study is to examine the relationship among latent constructs, rather than to validate new measures, and the scales used have well-established unidimensional structure, undertaking parcel based analyses would be not only appropriate but also likely to reveal structural patterns with enhanced accuracy". This argument was also confirmed by a more recent paper carried out by Little et al. (2013) that argue that if the study has the aim to understand the link between latent constructs the parcel method helps provide a "parsimonious representation of the construct" [37]. Since the CSES was already validated in Italy, showing its unidimensional nature and the aim of this study it is not to validate this scale but just figure out how it is in relation with the other latent variables considered in this study, the parcel method seems to be recommended. In particular, as suggested by Rogers and Schmitt (2004) three parcels were created for representing the social-influence construct, using random assignment [39,40]. These parcels were regarded as observed variables which represent the average scores of the corresponding items.

The final measurement model included two latent constructs (self-evaluation and interpersonal influence) and 7 observed variables (three parcels for the self-evaluation and four items for the interpersonal influence). To determine the goodness of fit, Beavers et al. (2013) proposed that the factor loadings < 0.40 are weak and factor loadings > 0.60 can be considered strong. Moreover, the acceptable threshold value for composite reliability (CR) is above 0.70, while that for average variance extracted (AVE) is above 0.50 [42]. Results confirm the hypothesized two factor measurement model and also all of the loadings of the observed variables on the latent variables were also significant, revealing that all of the latent constructs were well operationalized by their indicators (Table 2). In this model the errors of item 3 and item 4 are correlated due to the similarity of the words that compose these items ($r=0,62$, $p<0.001$).

Table 2. Confirmatory factor analysis properties.

	Stand. Factor loadings	SE	P	CR	AVE
Core Self Evaluation scale				0.84	0.64
CSES 1 (items 9, 8, 2, 5)	0.77	0.02	***		
CSES 2 (items 4, 10, 7, 3)	0.81	0.02	***		
CSES 3 (items 6, 11, 1, 12)	0.82	0.02	***		

Interpersonal Influence				0.80	0.53
Item 1	0.93	0.02	***		
Item 2	0.87	0.02	***		
Item 3	0.46	0.03	***		
Item 4	0.53	0.02	***		

Note. *** $p < .001$; $N=1004$; $\chi^2 = 20.619$; $df=12$; $p=n.s.$; $CFI=0.99$; $TLI=0.99$; $RMSEA=0.03$ ($LO90 = 0.00$, $HI90 =0.05$).

Table 3 shows that the estimated intercorrelations among the two latent variables (Self-evaluation and Interpersonal Influence) were less than the square roots of the AVE in each construct. This provides support for discriminant validity and thus reduces the potential influence of common method variance [43]

Table 3. Inter-correlations between two latent variables.

	M	SD	1	2
1.Core Self Evaluation scale	3.18	0.50	<i>0.80</i>	
2.Interpersonal Influence	3.80	1.23	-0.17***	<i>0.73</i>

Note: *** $p < .001$.; M= Mean; SD=standard deviation; $N = 1004$; The square roots of AVE for discriminant validity are italicized

4.3 The Structural model

Finally, a structural equation model (SEM) was run in MPLUS 8 on the total sample ($N=1004$) to assess, firstly, the relationships between self-evaluation and the interpersonal influence on the belief in fake news.

The model provided a very good fit to the data: $\chi^2= 50.055$; $df=17$; $p<0.001$; $CFI=0.99$; $TLI=0.98$; $RMSEA=0.04$ ($LO90 = 0.03$, $HI90 =0 .06$). In accordance with the hypothesis, interpersonal influence was negatively influenced by self-evaluation ($\beta = -0.17$, $p < .001$), confirming hypothesis 1, and the belief in Online fake news was positively influenced by interpersonal influence ($\beta = 0.20$, $p < .001$), confirming hypothesis 2.

In order to test the mediating role of interpersonal influence between the self-evaluation and belief in Online fake news, we tested both full mediation and partial mediation models, comparing them. The $\Delta\chi^2$ test showed that the partial mediation model had a better fit ($\Delta\chi^2 [\Delta df = 1] = 7.616$, $p < .01$) than the full mediation model. We further use the Bootstrap technique to figure out the mediating role of interpersonal influence. In Table 4 are shown the results of the total effect, indirect effect and direct effect. We note that interpersonal influence plays a partial mediating role in the relationships between self-evaluation and the belief in fake news (indirect effect= -0.04, $CI=-0.06$; -0.02) even if the effect is quite low. Nonetheless, hypothesis 3 is supported.

Table 4. Standardized indirect effect of the model.

	Bootstrapping

	Point estimate	SE	Percentile Bootstrapping 95% CI (confidence interval) of the coefficients.	
			Lower	Upper
Total effect				
Self-evaluation→Belief in fake news	-0.13	0.03	-0.19	-0.06
Indirect effect				
Self-evaluation→interpersonal influence→Belief in fake news	-0.04	0.01	-0.06	-0.02
Direct effect				
Self-evaluation→Belief in fake news	-0.09	0.03	-0.16	-0.03

Note: Mediator: interpersonal influence; Estimating of 5,000 bootstrap sample

4.4 The moderating effect of stages of change

To explore the moderating effect of stages of change, invariance tests of measurement model and structural model were conducted. First, CFA was employed for both groups (in change N=646; not in change N=358) without fixed factor loadings (configural model); while another CFA was conducted for both groups with fixed factor loadings (full-metric invariance model). Then, the two different models were compared. Table 5 demonstrates the results of measurement invariance test conducted for the two groups in change and not in change. The fit indices of configural model (RMSEA=0.039, CFI=0.995, TLI= 0.990) and metric invariance model (RMSEA=0.035, CFI=0.994, TLI= 0.992) indicate that both models achieve good model fit. In addition, the X^2 difference between both models ($\Delta X^2(5)=5.291$) is insignificant ($p= 0,38$) and the differences of CFI value between both models ($\Delta CFI=0.001$) reach the suggested standards ($\Delta CFI<0.01$) proposed by Cheung and Rensvold (2002), indicating that the changes caused by the different groups have only a slight impact on the measurement structure and can be neglected. Consequently, the analytical results show that metric invariance is supported and thus the multigroup analysis can be conducted.

Table 5. The results of measurement invariance test

MODEL	X^2	df	$\Delta X^2(\Delta df)$	Δdf	CFI	TLI	RMSEA	ΔCFI
Group "in change" (N=646)	13.909	12	-	-	0.999	0.998	0.016	-
Group "not in change" (N=358)	28.075	12	-	-	0.987	0.977	0.061	-
Configural model	41.984	24	-	-	0.995	0.990	0.039	-
Metric model	47.275	29	5.291 ^{ns}	5	0.994	0.992	0.035	.001

Note: Ns= not significant

Finally, we had tested the moderating effect of stages of change creating two nested models: unconstrained model and constrained model. In the unconstrained model all the parameters were freely estimated and in the second one the path coefficients from interpersonal influence to belief in fake news were set to be equal. After that, the two models were compared ($\Delta\chi^2_{(1)} = 9.591$, $p < 0.01$), and these results show that there is a moderating effect caused by the different stages of change (see Table 6). In addition, the results show that in the “in change” group the path coefficient between the interpersonal influence and the belief in fake news is 0.279*** ($p < 0.001$) while it is 0.059 ($p = \text{n.s.}$) in the “not in change” group. As expected, when people are in change and want to improve the safety and the health of their eating style, the positive relationship between interpersonal influence and the belief in fake news will be stronger. Therefore, H4 is supported.

Table 6. Invariance test of the two-group structural model.

MODEL	χ^2	df	$\Delta\chi^2_{(\Delta df)}$	Δdf	CFI	TLI	RMSEA	ΔCFI
Unconstrained model	77.172	34	-	-	0.987	0.979	0.050	-
Constrained model	86.763	35	9.591(**)	1	0.985	0.976	0.054	-.002

Note:** $p < 0.01$

5. Discussion

This research shows how social interpersonal influence mediates the relationship between individual self-evaluation and the belief in online fake news and that, with an equal predisposition to social influence, people who are planning to change their lifestyle are more likely to believe in food-related online fake news than those who do not intend to change.

These results confirm our original hypothesis that psychological individual and social factors play an important role in determining why some individuals are more vulnerable to the persuasive power of online fake news, especially in the field of food consumption and nutrition. These results underline that individuals are not merely passive receivers of information, demonstrating that this phenomenon it is much more complex than it has been studied so far. In line with these reflections, Pennycook and Rand (2017, 2019, p. 7) found that the tendency of individuals to be sceptic or to have a higher “*pseudo profound bullshit receptivity*” can better explain the persuasive power of fake news than the cognitive process related to the repetition of the stimulus. More in particular, it was also demonstrated that the collective opinion of others influences the evaluation of the truthfulness of some news related to food [47], underling how the predisposition to social influence could do the difference in the phenomenon of fake news. Our study also confirms these previous results, highlighting how the psychological individual self-evaluation is mediated by the susceptibility to social influence in impacting online fake news believing. In addition, this study added an innovative dowel to the study of fake news related to food choices, but understanding the role of the motivation to change in believing in this news. Our results indeed showed that psychological individual or social factors do not impact the people’s believing in fake news in the same way for everyone, but that it depends on the individual predisposition to change. When individuals are seeking for a change in their life, they are not only more motivated to seek information [16], but also more vulnerable to social influence and fake news. In other terms the psychological readiness to change their lifestyle may open a door in people life, thus interrogating them about their food and dietary plans, which can result in an increased willingness to search more information. The increased interest in information seeking, indeed, can be deleterious if it leads people to believe in all (mis)information and

change their food habits in improper or inadequate diets. On the contrary, it could be turned into an opportunity if it is guided: being able to diagnose people readiness to change lifestyle and food habits is an important cue to support and engage them in their correct information-seeking behaviours and healthier food habits. For instance, public health institutions and food companies could catch this time opportunity to establish a dialogue with the consumers and help them in finding a proper direction. In addition, it could be an opportunity to take advantage of people's willingness to change and to be active in their choices as a key to engage them in a fruitful relationship with the other actors of the system, thus building support and trusted network [48].

Although this research produced interesting results, it has some limitations. The frequency of beliefs in fake news is based on a self-reported item: this may be biased by memory and social desirability in the survey process. Moreover, we have not considered some variables that could affect the belief of fake news such as socio-demographic characteristics (e.g. age, level of education) and internet usage behaviours (e.g. timing of use, information platforms used). Finally, our study focused on general fake news belonging to the food field without considering whether the phenomenon of believing in fake news could change based on different types of fake news in the food sector, or if this is peculiar of certain types of foods. Further research may be conducted to better scrutinize the phenomenon of fake news by introducing other very topical variables as suggested before.

6. Conclusions

This research highlights how the belief in online fake news in the food sector is determined by some psychological variables and by the individual predisposition to change. Specifically, the predisposition to social influence affects the belief in online fake news if people are in a phase of dietary change since they are more open and predisposed to receive information and to listen to the advice of others. These results underline that the use of algorithms to limit the spread of online fake news can only partially solve the problem as psychological understanding of the phenomenon is an important variable within the process, both to prevent the believing and spread of fake news in the food area, and – consequently - to engage the people towards adequate food conducts. In light of this, the study underlines the urgent need to educate consumers, especially those most exposed to fake news risk, to prevent them from unhealthy eating behaviours determined by the believing in online false news.

Supplementary Materials: questionnaire A: Questionnaire filled out by the sample

Author Contributions: This paper derives from a collaboration of the authors. G.C.: Conceptualization, Methodology, Formal analysis, Writing - Original Draft. M.S.: Validation, Investigation, Writing - Review and Editing. G.G.: Data Curation, Writing - Review and Editing, Supervision. All authors have approved the final article.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study

Data Availability Statement: The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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