

BEYOND THE USE OF FOOD SUPPLEMENTS: AN EMPIRICAL ANALYSIS IN ITALY

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ABSTRACT

This paper aims to profile Italian food supplements used by consumers based upon their psychometric patterns and demographic characteristics. The FTNS scale is used to assess empirically and evaluate the role of technophobic/technophilic consumer traits in determining the decision whether or not to consume supplements and vitamins and the frequency of their consumption. An ad-hoc survey was carried out in 2012 involving 400 residents of a metropolitan area in southern Italy. Our results show that women have a higher consumption frequency of dietary supplements, while age, BMI and education influence the propensity to consume. As regards food habits, the propensity to use dietary supplements is positively associated to the consumption of bread and pasta, red meat and pulses, and negatively with the consumption of fruit and cheese. Finally, the research supports the role of technophobic traits as consistent and significant determinants of the consumption frequency of dietary supplements.

- Keywords: consumption, neophilia, vitamins -

1. INTRODUCTION

Food supplements are edible products that include components proposed as a dietary enhancement (US Food and Drug Administration, 1994), regulated as food rather than drugs at least in the majority of developed countries. The dietary components might include vitamins, minerals, proteins (metabolites, enzymes and amino acids) and energy concentrate (energy bars).

Although by the end of the 1990s the use of dietary supplements was relatively frequent in industrialised countries, the consumption of such supplements has been further boosted in all the more affluent Western countries by new motivations associated to ageing populations and to continually changing lifestyles (BLENDON *et al.*, 2001; GRAGAR, 2001; BABGALEH *et al.*, 2006; FELDMAN, 2014). In recent years, as regards general food consumption, ever more consumers have shifted from mere satisfaction of energy requirements to an attitude dictated by the need to promote well-being and reduce the risk of disease (MARQUES-VIDAL, 2004). In the US, the market for dietary supplements has grown dramatically in recent decades, recording an almost 80% increase from 1994 to 2000 (GREGER, 2001; BALLUZ *et al.*, 2005). In Italy, according to a recent survey by GfK Eurisko and Federsalus, for example, three out of every four individuals stated that they used at least one supplement for personal well-being in 2012. Wellness trends are generating new opportunities and challenges for companies in the vitamin and dietary supplement sector, and the producers of dietary supplements have substantially increased their investments and studies to ascertain the behaviour of consumers *vis-à-vis* food supplements. This analytical need is also emerging at scientific level with a view to understanding not only the consumption dynamics of such products but also the various underlying motivations (NICTER and THOMPSON, 2006; O'CONNOR and WHITE, 2010; TAVANI *et al.*, 2014). In this regard, medical research and economic research are proceeding apace. The former aims to gain insights into the effects that food supplements have on the well-being of the individual, or the harmful effect of their excessive use to be able to better satisfy the demand for information and steer consumption of these products (GREGER, 2001); by contrast, economic research aims to analyze markets opportunities and challenges for new or existing products and the regulations for consumer information (RUSSO FRANCE and FITZGERALD BONE, 2005).

Furthermore, a large strand of research aims to profile consumers of supplements. In the UK, users of supplements are primarily female, vegetarian, less likely to drink alcohol, non-smoking, and more likely to engage in physical activities (KIRK *et al.*, 1999). Similar results were

confirmed in the US (LYLE *et al.*, 1998; GREGER, 2001; ROCK, 2007). The increasing number of users is dictated by a strong aspiration towards better health (GREGER, 2001), by the need to protect one's state of health and at the same time lower the risk of disease, rather than only satisfy metabolic needs (ROBERFROID, 2000; GREGER, 2001; COX *et al.*, 2004; MARQUES-VIDAL, 2004).

Although health considerations appear to be a predominant incentive in choosing to use dietary supplements, the reasons for consuming such supplements are complex, combining social, psychological, educational and economic factors. A paradox has been pointed out (CONNER *et al.*, 2001): consumers of dietary supplements generally have higher recorded nutrient intakes from food sources alone than those who do not consume supplements. Although only a small percentage of individuals go beyond the line of reasonable consumption, those consuming excessively may sustain harmful effects (MEDEIROS *et al.*, 1999). This seemingly irrational behaviour provides the motivation to discard the neo-classical approach which analyses the consumer's rational choice as a utility maximisation process under budget constraint and graduate towards the use of analytical instruments that investigate individuals' cognitive and affective factors and their relations with consumption behaviour (VERNEAU *et al.*, 2014).

For instance, using a psychosocial model, the Protection Motivation theory, COX *et al.* (2004) analysed which characteristics of the product/message would impact on the motivations to purchase dietary supplements to prevent short-term memory loss. RUSSO FRANCE and FITZGERALD BONE (2005) examined the information environment in the dietary supplement industry. They analysed consumer product-specific as well as general beliefs about health, the supplement industry and the government. Their results suggest that information regarding a particular product can be overridden by the consumer's existing and distantly related beliefs.

Dietary supplements and vitamins represent a product category that falls between - and links - food and medicine, and therefore the perception of these products might also be influenced by the effect of risk. On this field, O'CONNOR and WHITE (2008) analysed consumers' willingness to trial functional foods and vitamin supplements. They found support for the Theory of Planned Behaviour (TPB) model in predicting people's willingness to trial functional food and vitamin supplement. The authors also suggested that non-users are influenced by the high-perceived risk associated with their use. According to the psychometric paradigm proposed by SLOVIC (1987), the more people are familiar and well informed about specific hazards, the lower is the perception of risk towards emerging technologies. In other words, the risk perception is affected by the knowledge of both

risks and benefits related to novel food technologies (FIFE-SCHAW and ROWE, 1996, SIEGRIST *et al.*, 2006). Thus, when knowledge is lacking, consumers' assessment of risks and benefits related to novel food products and emerging technologies is driven by heuristics (SIEGRIST *et al.*, 2008) and among them, trust and perceived naturalness have been identified as powerful factors (FREWER *et al.*, 2003; BRONFMAN *et al.*, 2008; CHRYSOCHOIDIS *et al.*, 2009; EARLE and SIEGRIST, 2008; KJÆRNES, 2006; ROZIN *et al.*, 2004; STEPTOE *et al.*, 1995). SIEGRIST *et al.* (2008) have shown, for instance, that food products perceived as natural and healthy are more likely to be accepted by consumers.

Various psychometric scales have been developed and tested to study consumer acceptance towards new technology and, more generally, new food (GOLDSMITH and HOFACKER, 1991; PLINER and HOB DEN, 1992; EISER *et al.*, 2002; KIRK *et al.*, 2002; COX *et al.*, 2007; COX and EVANS, 2008). Among them, the Food Technology Neophobia Scale (FTNS) (Cox and Evans, 2008) has been judged to be a more suitable tool for assessing consumer fears of food technologies than an earlier food neophobia scale (FNS) (PLINER and HOB DEN, 1992) because of its specific focus on technology rather than food (MATIN *et al.*, 2012). The FTNS is a multidimensional scale which integrates the main drivers previously discussed, including naturalness, trust and perception of both risks and benefits of novel food technologies (COPPOLA *et al.*, 2014; VERNEAU *et al.*, 2014; COX *et al.*, 2010).

In this study, we adopted the FTNS to assess empirically and to evaluate the role of technophobic/technophilic traits in determining whether or not to consume supplements and vitamins and their consumption frequency. Moreover, to the best of our knowledge, the potential effect of the technophobia and technophilia traits in affecting this decision is still underexplored and this work is probably the first quantitative attempt to ascertain the determinants of supplement consumption in Italy.

While an empirical analysis of the motivations behind their use or non-use can be considered strategic for the industry sector to improve product penetration, assessment of the determinants of their consumption frequency is even more important in the policy debate on public health. Ascertaining the profile of consumers who are likely to use them excessively is an important step towards prevention.

The market for dietary supplements in Italy is one of the largest in Europe: it reached nearly 2 billion euros in 2013, showing an annual increase of around 3% (COUSYN *et al.*, 2013). The results show whether, and to what extent, the degree of consumer technophilia and hence the perception of risk for novelty and neophilia are associated, if at all, with dietary supplement consumption.

2. MATERIAL AND METHODS

2.1 The survey

An *ad-hoc*, face-to-face survey was conducted in 2012 with a convenient sample of 400 residents of the Naples metropolitan area (southern Italy). The questionnaire used for data collection comprised three sections.

Section a) includes socio-demographic characteristics and lifestyle factors including physical activities (such as gym and sport activities).

Section b) includes the consumption frequency scale for five categories of dietary supplements, namely mineral supplements, amino acid and/or protein supplement, vitamin supplement, beverages enriched with vitamins or minerals, and energy and protein bars. Several classifications of food supplements are proposed by the scientific literature, varying among those focusing on the product's functionality (RADIMER *et al.*, 2000), ingredients (SKEIE *et al.*, 2009), disease perspectives (MILLEN *et al.*, 2004) or consumer's point of view (TAVANI *et al.*, 2014). This paper adopts a market-driven classification, coherently with the European Commission directive (2002/46/EC) and with the Italian Legislation (Legislation Decree 169/2004), which characterizes food supplements as concentrated sources of nutrients for supplementing the intake in a normal diet (primarily vitamin, mineral salts and amino acids).

For each product, respondents were asked to select one of the following five options, labelled 0 "I do not consume the product", 1 "I seldom consume the product (no more than once a month)", 2 "I occasionally consume the product (no more than once a week)", 3 "I consume the product frequently (more than once a week)" and 4 "I regularly eat the product (almost every day)". The above frequency scale of consumption can be considered an easily quantifiable measure of the phenomenon under observation in this study, namely individual consumption of dietary supplements. Furthermore, section b) comprises consumption frequency of all the other food categories in order to represent the whole consumption habits of the respondents.

Section c) comprises the Food Technology Neophobia Scale for investigating consumer attitudes to technology using the 13 items provided by COX and EVANS (2008). The FTNS translated into Italian were provided to the respondents who were called upon to express their degree of agreement-disagreement by using a Likert 7-point agree/disagree scale on their perception of new food technology, its uses, benefits and associated risks; the way they feel in new situations and behave when facing unknown circumstances; their food habits and the propensity to taste new food products.

2.2 The analytical framework

From an empirical point of view, individual consumption decisions on dietary supplements may be modelled through a two-stage process. In the first stage, individuals decide whether or not to consume supplements. In the second stage, the individuals shape their consumption habit by consumption decisions over time (CEM-BALO *et al.*, 2014). The second stage decision is approximated here through a consumption frequency scale.

If the first stage could be of interest for marketing purposes, for identifying segments ready or “nearly” ready for the use of supplements, the second stage is particularly important for public health policy reasons, since it investigates the determinants of the use (including the excessive use) of dietary supplements. Both stages may depend on several individual factors involving interaction among the cognitive, social and cultural dimensions of consumption. In this paper we formally assess the extent to which neophobia-neophilia forces may influence such decisions. This study implements the Food Technology Neophobia Scale (FTNS) proposed by Cox and Evans (2008), allowing consumers with greater neophilia attitudes to be identified, potential early adopters of dietary supplements. Moreover, dietary supplement consumption decisions could depend on individual socio-characteristics and overall diet. Therefore other variables capturing these consumer characteristics and described in the previous section are included in the model.

Analytically, a two-step Heckman procedure (1979) can be used to analyse both stages of consumption decisions. As concerns the first stage, we assumed that observable characteristics of the consumers influence their consumption choices in terms of the probability that the consumer will use dietary supplements. Considering a sample of n observations indexed by i , the outcome $\{y_i\}$ of whether or not to consume is a qualitative random variable taking in the presented case two levels: 0, 1.

$$y_i = \begin{cases} 1 & \text{if } C_i^* > 0 \\ 0 & \text{if } C_i^* \leq 0 \end{cases}$$

where C_i^* indicates consumption over time. Empirically, this relation can be analysed through Probit specification as

$$\begin{aligned} \pi_i &= \text{Prob}(y_i=1) = \text{Prob}(C_i^* > 0) = \\ & \text{Prob}(-u_{1i} < \mathbf{x}'_{1i}\boldsymbol{\beta}_1) = \Phi(\mathbf{x}'_{1i}\boldsymbol{\beta}_1) \end{aligned} \quad (1)$$

where π_i identifies the probability that the i -th respondent consumes the dietary supplement, u_{1i} is the error term, (i.i.d.) $\sim N(0,1)$, Φ is the cumulative density function of a standardized normal distribution, \mathbf{x}'_{1i} is the set of k_1 consum-

er characteristics influencing the probability of consuming dietary supplements while $\boldsymbol{\beta}_1$ are the respective parameters to be estimated.

As regards the second stage, consumption frequency, we may focus only on the “consumers” or the individuals who have decided to consume a dietary supplement at least once, ($y_i = 1$). More specifically, a positive consumption over time, (C_i^*), is observed only if a consumer chooses to consume dietary supplements: $C_i^* > 0$. Formally, we can write the selection equation and the resultant outcome equation for C_i^* as follows:

$$\begin{aligned} \mathbf{x}'_{1i}\boldsymbol{\beta}_1 + u_{1i} &> 0 \text{ (selection equation)} & i = 1, 2, \dots, n_i \\ C_i^* &= \mathbf{x}'_{2i}\boldsymbol{\beta}_2 + u_{2i} \text{ (outcome equation)} & i = 1, 2, \dots, n_i \end{aligned} \quad (1)$$

where

$$\begin{bmatrix} u_1 \\ u_2 \end{bmatrix} \sim N(\mathbf{0}, \boldsymbol{\Sigma}) \text{ and } \boldsymbol{\Sigma} = \begin{bmatrix} 1 & \cdot \\ \sigma_{12} & \sigma_2 \end{bmatrix}$$

Assuming that consumption frequency is influenced by a set of k_2 explanatory variables \mathbf{x}_2 , we wish to estimate $\boldsymbol{\beta}_2$ parameters, under sample selection, with a potential source of inconsistency as:

$$E(C_i^*/\mathbf{x}_2, C_i^* > 0) = \mathbf{x}'_{2i}\boldsymbol{\beta}_2 + E(u_{2i}/C_i^* > 0) \quad i = 1, 2, \dots, n_2.$$

Because error terms have a bivariate normal distribution, the expectation $E(u_{2i}|C_i^* > 0)$ is equal to $\sigma_{12}\lambda_i(\mathbf{x}'_{1i}\boldsymbol{\beta}_1)$ where λ_i is known as the inverse of the Mills' ratio:

$$\lambda_i(\mathbf{x}'_{1i}\boldsymbol{\beta}_1) = \frac{\phi(\mathbf{x}'_{1i}\boldsymbol{\beta}_1)}{\Phi(\mathbf{x}'_{1i}\boldsymbol{\beta}_1)} \quad i = 1, 2, \dots, n_2$$

where $\phi(\bullet)$ is the probability density function of the standard normal distribution.

Following Heckman (1979) a consistent estimation of $\boldsymbol{\beta}_2$ and σ_{12} can be obtained by augmenting the outcome equation with the inverse of the Mills' ratio obtained from the estimates of the selection equation. In order to obtain a better identification of the Heckman model, we also impose exclusion restrictions (exclusion of at least one regressor being significant in the selection part, but not in explaining the outcome). The augmented equation was estimated by OLS using a linear functional form, while test statistics are based on Huber-White Sandwich estimation of variance.

The dependent variable of the outcome equation C_i^* is based on the stated frequency of consumption of the five categories of dietary supplements, and more precisely is defined as a linear additive aggregation of their stated frequency:

$$C_i^* = \sum_{d=1}^5 S_{d,i}$$

where $S_{d,i}$ represents the stated frequency consumption score of the d -th dietary supplement for the i -th individual.

Table 1 - Stated frequency of consumption/use of dietary supplements.

	Mineral supplements	Protein supplements	Vitamin supplements	Enriched drinks	Energy bars
Never	56.25	83.7	53.53	39.95	75
Seldom	30.43	10.05	30.43	39.95	15.76
Monthly	9.24	2.72	10.05	14.4	7.34
Weekly	4.08	3.53	5.98	5.71	1.9
Daily	0	0	0	0	0

3. RESULTS

3.1 Descriptive results

Of the 400 respondents 9% failed to complete the survey or to answer key questions fully and thus, the final sample is based on 368 individuals. Socio-demographic information shows that the interviewees (165 male and 203 female; Italian frequency of female) were in the age range 17–70 years (32 ± 11 years; Italian average 43.0, Italian National Institute of Statistics 2011). Almost one third of consumers (30.7 %) fail to do any physical activity, while the others spend one hour per day on average. Just over half the interviewees have university degrees (Italian average 11.7%, Italian National Institute of Statistics 2011), while 7% had achieved minimum education levels (Italian average 21.7%, Italian National Institute of Statistics 2011). As regards the Body Mass Index (BMI), 66% of respondents were normal weight (BMI 18.5–24.9 kg/m²) (Italian average 52.6%, World Health Organization 2005). These differences with the Italian population could be due to the specific context in which survey was carried out (residents of Naples metropolitan area).

Table 1 reports the stated frequency of consumption for the various categories of supplements: enriched drinks and vitamin supplements appear to be the supplements with a highest penetration rate in our sample, while energy bars and protein supplements report the lowest penetration rate. Around 50 % of respondents stated they used at least one vitamin supplement in the past; this percentage rises to 60 % when considering enriched drinks. Only 25 % and 15% of the respondents stated they had made previous use of energy bars and protein supplements, respectively. Overall, about 75% of the respondents declared to have consumed at least one category of food supplements in the past. This result is in agreement with data reported by Gfk-Eurisko and FederSalus.

Table 2 summarises the main characteristics of the respondents divided into two groups: consumers of dietary supplements and non-consumers.

From a preliminary analysis of the average

values between the two groups, we found that consumers of dietary supplements seem younger than those not consuming dietary supplements. Among the different types of dietary supplements, the beverages enriched with vitamins or minerals are those most commonly consumed while amino acid and/or protein supplements are those least consumed (Table 2).

As regards dietary habits, consumers of dietary supplements compared to non-consumers show a higher consumption frequency for meats (both red and white meat), snacks and sugary drinks, while they show a lower consumption frequency for cheese, fruit and salad (Fig. 1).

For consumers of dietary supplements the consumption index (Fig. 2) assumes a mean value of 3.57 ± 2.5 in the range (1-13), while it necessarily assumes a value of zero for non-consumers.

Respondents general attitudes towards novel technology and how its benefits and risks are perceived are assessed by means of the 13 psychometric items of the FTNS (Table 3). Consumers of dietary supplements compared to non-consumers show a higher FTNS score. Cronbach's α of the scale is 0.83, indicating very good internal reliability. The mean level of agreement stated on a scale from 1 to 7 shows in the sample that the statements with the highest rates are "There is no sense trying out high-tech food products because the ones I eat are already good enough" together with "New foods are no healthier than traditional foods" and "The benefits of new food technologies are often grossly overstated". These results seem in agreement with those of VERNEAU *et al.* (2014), highlighting that there is a great belief in Italian society in supporting natural foods, the Mediterranean diet along with the promotion of local and typical products. In turn, this outcome might reflect the opinion that innovation and manipulation in the food industry is somewhat futile, since traditional food products are often more highly appreciated and healthier.

By comparing the mean FTNS score for the entire sample (mean = 55.2, sd = 13.7, range 16–85) with those evaluated from other studies, it may be stated that our sample from the Naples metropolitan area presents less fear of food compared to the whole Italian population (mean =

Table 2 - Sample descriptive statistics according to consumption of dietary supplements.

Variable	Average	Std. Dev.	Min	Max	Average	Std. Dev.	Min	Max
	Non-consumers of dietary supplements				Dietary supplement consumers			
<i>Socio-demographic characteristics</i>								
Age (years)	38.94	13.85	20	71	30.05	9.92	17	70
Gender (2 male; 1 female)	1.61	0.49	1	2	1.53	0.50	1	2
BMI	24.04	3.23	18.14	34.29	23.06	3.72	17.02	40.14
Education classes ^a	3.51	0.69	1	4	3.44	0.62	1	4
Presence of children (1 yes; 0 no)	0.88	0.33	0	1	0.91	0.28	0	1
Physical activity (hours per week)	7.50	10.46	0	45	6.85	8.31	0	45
Income classes ^b	2.41	0.71	1	4	2.35	0.83	1	4
<i>Dietary habits</i>								
Salads	2.41	0.78	0	4	2.29	0.89	0	4
Other vegetables	2.40	0.78	0	4	2.33	0.80	0	4
Fruit	3.16	0.97	0	4	2.85	1.09	0	4
Pulses	1.78	0.50	0	3	1.93	0.62	0	4
Milk & yogurt	2.50	1.11	0	4	2.51	1.11	0	4
Cheese	2.11	0.70	0	4	1.91	0.86	0	4
Red meat	1.83	0.54	0	3	1.98	0.48	0	4
White meat	2.00	0.54	0	3	2.09	0.56	0	4
Eggs	1.62	0.62	0	3	1.69	0.71	0	4
Bread and Pasta	2.87	0.72	0	4	2.99	0.75	0	4
Sugary drinks	1.23	1.03	0	4	1.48	1.14	0	4
Snacks	1.56	1.07	0	4	1.94	1.13	0	4
Wine & Beer	1.23	1.06	0	4	1.30	1.05	0	4
<i>Dietary supplement consumption^c</i>								
Mineral supplements	0	0	0	0	0.79	0.85	0	3
Amino acid and/or protein supplement	0	0	0	0	0.34	0.75	0	3
Vitamin supplements	0	0	0	0	0.88	0.91	0	3
Beverages enriched with vitamins or minerals	0	0	0	0	1.10	0.84	0	3
Energy and protein bars	0	0	0	0	0.47	0.77	0	3

^a(1 primary school; 2 middle school; 3 high school; 4 university and higher);
^b(1 less than €1,000 per month; 2 €1,000-2,000; 3 €2,000-3,000; 4 more than €3,000);
^c(0 no consumption; 1 rare consumption, once a month; 2 frequent consumption, once a week; 3 very frequent consumption, more than once a week; 4 additive consumption, every day).

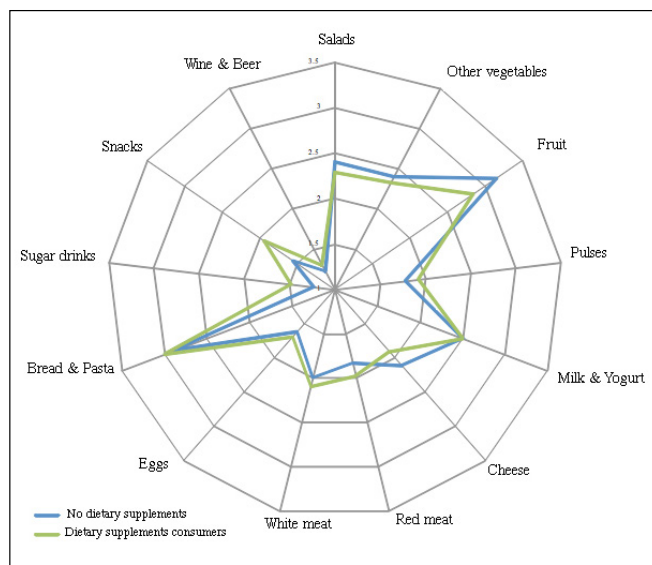


Fig. 1 - Comparison of dietary habits of respondents consuming dietary supplements and those not consuming.
 Note: the scale range from 0 "I do not consume the product", to 4 "I regularly eat the product (almost every day)".

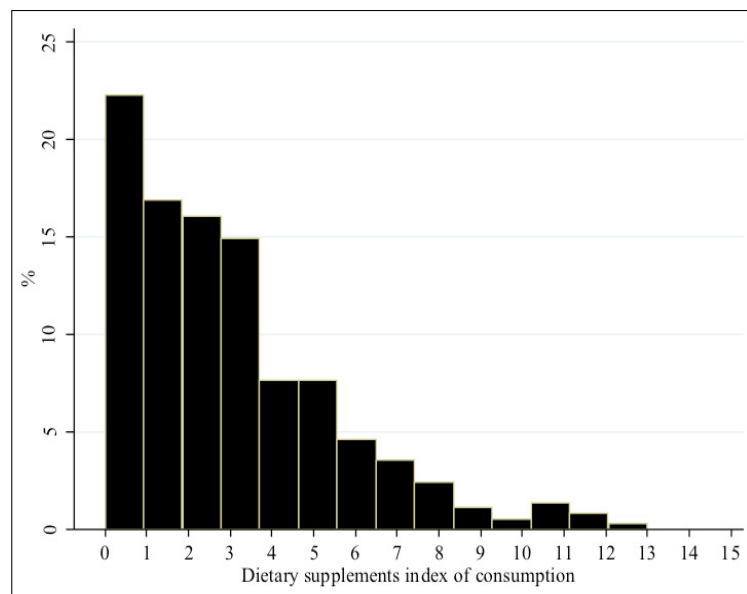


Fig. 2 - Frequency distribution of the dietary supplement index of consumption.

Table 3 - Descriptive statistics - Cox psychometric questions: item score on a 1 to 7 scale (1= strongly disagree; 7= strongly agree).

FTNS statements	Mean (Total Sample)	Std. Dev. (Total Sample)	Mean (Non-consumers of dietary supplements)	Mean (Dietary supplement consumers)
There is no sense trying out high-tech food products because the ones I eat are already good enough	4.8	1.8	5.38***	4.64
New food technologies are something I am uncertain about	4.2	2.0	4.48*	4.14
New foods are no healthier than traditional foods	4.6	2.0	4.73	4.53
The benefits of new food technologies are often grossly overstated	4.6	1.8	4.70	4.57
There are plenty of tasty foods around, so we do not need to use new food technologies to produce more	4.2	2.1	4.46*	4.14
New food technologies decrease the natural quality of food	4.3	1.9	4.51	4.22
New food technologies are unlikely to have long term negative health effects (R)	4.1	1.7	4.19	4.10
New food technologies give people more control over their food choices (R)	3.9	1.7	4.07*	3.80
New products using new food technologies can help people have a balanced diet (R)	4.2	1.4	4.28	4.11
New food technologies may have long-term negative environmental effects	4.0	1.8	4.21*	3.88
It can be risky to switch to new food technologies too quickly	4.2	1.8	4.45*	4.10
Society should not depend heavily on technologies to solve its food problems	4.6	1.9	4.77	4.56
The media usually provides a balanced and unbiased view of new food technologies (R)	3.7	1.9	3.75*	3.45

Note: Cronbach's α : 0.832; (R) means the item is reverse-coded.
*Difference across mean significant at the 10% level; ** at the 5% level; *** at the 1% level.

61, sd = 11.3, VERNEAU *et al.*, 2014). That said, our results are comparable with those obtained with Canadians (mean = 58, MATIN *et al.*, 2012) and Australians (mean = 54, EVANS *et al.*, 2010).

3.2 Propensity to consume dietary supplements

The two-stage process of individual consumption decisions on dietary supplements is shown in Table 4.

Variables not significant at the $p < .10$ level in explaining any of the two stages are eliminated from the final models, starting with the least significant variable. On the left are the results of the first stage, indicating the individual determinants of the decision whether or not to consume dietary supplements. The results show that the propensity to consume dietary supplements depends on the age of the respondents (the latter is significantly associated with a lower propensity to consume dietary supplements)

Table 4 - I Stage and II Stage estimates.

	I Stage: Propensity to consume dietary supplements				II Stage: Consumption frequency decision			
	Coef. β_1	Elasticity	Std. Dev.	p-value	Coef. β_2	Elasticity	Std. Dev.	p-value
<i>Socio-demographic</i>								
Cons.	3.389		1.264	0.007	7.102		2.913	0.015
Age	-0.034	-0.353	0.007	0.000	-0.003	-0.044	0.036	0.924
Sex	-0.101	-0.051	0.182	0.579	-0.889	-0.541	0.370	0.016
Edu.	-0.284	-0.319	0.132	0.031	-0.284	-0.385	0.354	0.422
BMI	-0.043	-0.329	0.026	0.095	-0.118	-1.081	0.062	0.058
<i>Food Habits</i>								
Fruit	-0.136	-0.129	0.083	0.103	0.010	0.011	0.178	0.956
Pulses	0.274	0.170	0.148	0.063	0.436	0.325	0.330	0.186
Cheese	-0.263	-0.168	0.108	0.015	-0.451	-0.345	0.282	0.110
R. Meat	0.346	0.219	0.179	0.053	0.308	0.235	0.470	0.512
W. Meat	0.085	0.057	0.163	0.603	1.093	0.889	0.329	0.001
Bread& Pa	0.186	0.180	0.111	0.094	0.261	0.304	0.268	0.330
<i>Attitudes</i>								
FTNS	-0.191	-0.088	0.383	0.619	-2.083	-1.161	0.753	0.006

and on their BMI values (higher consumption of dietary supplements is associated with lower BMI levels). Respondent education also plays a major role in determining consumption decisions (DIAMANTOPOULOS *et al.*, 2003). Our estimate shows that less educated respondents are associated with a higher propensity to consume dietary supplements. Daily eating habits are a particularly significant factor affecting propensity to use supplements (KIM and KEEN, 2002). Our estimates show that intakes of carbohydrate and protein from the diet differ between those using or not using dietary supplements. Respondents who often consume refined cereals (bread and pasta), red meat and pulses show a higher propensity to use dietary supplements compared to those frequently consuming fruit and cheese. Finally, the attitudes of individuals to food technology measured through the FTNS do not appear to affect this propensity significantly.

3.3 Frequency of dietary supplement consumption

The results of the second stage on the determinants of the frequency of the supplements use is also reported on Table 4.

Studies in the US and Europe have shown that females, individuals in high socioeconomic categories, and individuals living in large cities are likely to use dietary supplements more often than others (SLESINSKI *et al.*, 1995; SCHELLHORN *et al.*, 1998). Our results confirm that women show a higher consumption frequency of dietary supplements. As regards the remaining socio-demographic characteristics, only the BMI value seems to influence (in inverse relation) the use of supplements. Although daily eating habits proved clearly associated to the propensity to use supplements, such habits almost entirely fail to explain respondents' consumption frequency. Only the consumption frequency of one food category over the 13 tested (white meat) is significantly associated to a higher use of supplements. Estimates show an elastic complementary relationship between the consumption of white meat and supplements intake. However, with the exception of age, BMI and the frequency of white meat consumption, the great majority of the socio-demographic variables collected and used in the analysis are unable to explain the consumption frequency of dietary supplements. In this case, analytical instruments that investigate individuals' cognitive and affective factors might help to profile the consumers of supplements.

The attitude of consumers to food technologies, as measured by the FTNS, effectively contributes to meeting this requirement. Specifically, respondents characterised by neophobia patterns and consequently showing low demand for novelty and neophilia are associated with a

low consumption of dietary supplements. Furthermore, the estimated association between the FTNS and the index of supplements' frequency of consumption is quite strong (elasticity -1.161).

4. DISCUSSION AND CONCLUSIONS

Dietary supplements are a relatively new class of product that has gradually become established on the markets, especially in the US, but that is rapidly increasing its penetration also in European and Italian markets. However, this trend has generated several major issues and posed a number of challenges. For example, it has been shown that consumers have a certain difficulty in interpreting the claims of such products, both as regards functions and disease prevention. Moreover, general and specific beliefs systematically bias product-specific judgments regarding efficacy as well as scientific certainty. This leads to questions as to how such labels are interpreted by those at risk or affected by specific diseases.

Another important issue stems from the evidence that the use of dietary supplements is at least partially motivated by self-control of health (EISENBERG *et al.*, 1998; GREGER, 2001). This can lead many people to make inappropriate choices, for example, favouring the use of dietary supplements compared to proper varied nutrition, especially among those who are more vulnerable to pressure to use dietary supplements unnecessarily, despite the lack of evidence to suggest they are needed to meet dietary deficiency. It is this group, namely the more vulnerable, that needs to be able to make an informed choice so that their use of dietary supplements is connected to real rather than perceived need. This presents a paradox, because dietary supplements, which are used to enhance human health, have the potential to create distortions in eating habits, keep people from the objective of a healthy and complete diet, and may cause adverse reactions when used inappropriately and taken in excessive amounts. For these reasons, the study of consumer behaviour and analysis of the motivations that cause them to consume dietary supplements or otherwise is particularly important for both policy makers and industry.

While the major studies that have analysed supplement-taking behaviour are focused on motivational systems, primarily resorting to Protection Motivation theory (PMT) and Theory of Planned Behaviour (TPB) (CONNER *et al.*, 2001; COX *et al.*, 2004; O'CONNOR and WHITE, 2010), in our research we tested the role of attitude to food technologies as a predictor of the intention to consume dietary supplements. In particular, we analysed the role of food technology neophobia/neophilia, which has been extensively researched with reference to a great number of food products, technologies and attributes (ARVOLA *et*

al., 1999; HENRIQUES *et al.*, 2009; TOURILA *et al.*, 2001). Testing food technology neophobia/neophilia in the case of dietary supplements seems to be particularly useful because, at least from a marketing point of view, this class of product is difficult to classify, lying at the crossroads of food and drugs. Furthermore, this paper provides the first empirical attempt to profile dietary supplement consumers in Italy.

The study outlined three main results: first of all, our analysis shows two different patterns for users and non-users. Secondly, results show that being young, female, less educated and having a low BMI are factors that are associated to higher propensity to consume dietary supplements. As regards food habits, the propensity to use dietary supplements is positively associated to the consumption of refined cereals (bread and pasta), red meat and pulses. On the contrary, propensity to use dietary supplements is negatively related to consumption of fruit and cheese. The investigation of whether these factors are similar to those associated with dietary deficiency/excess goes beyond the scope of the current analysis and would require another study with that specific objective. Finally, the research supports the role of technophobic traits as important determinants of the consumption frequency of dietary supplements: consumers of dietary supplements compared to non-consumers show a higher FTNS score. In particular, non-consumers of dietary supplements endorse the notions that *"There is no sense trying out high-tech food products because the ones I eat are already good enough"*, *"New food technologies are something I am uncertain about"* and *"It can be risky to switch to new food technologies too quickly"*. On the other side, consumers of dietary supplements show higher trust levels than non-consumers, and they highlight the benefits of the new technologies, agreeing with the statements *"New food technologies give people more control over their food choices"* and *"The media usually provides a balanced and unbiased view of new food technologies"*.

It would appear that a negative attitude to food technologies has the capacity to contain the consumption of dietary supplements within lower levels. Bearing in mind the potential challenges linked to the increasing consumption of dietary supplements, this finding may steer communication policies and information towards the specific group of people less affected by food technophobia. More generally, the results confirm the FTNS as a powerful tool to capture technophobic traits.

The findings of this study suggest that the introduction of some risk-based construct, namely the technophobic traits measured by means of the FTNS, might strengthen standard TPB models when health-related products like vitamins and dietary supplements are considered. However, surveying residents from a single metro-

politan area may limit generalisability of the results to different areas.

Further studies could follow two different avenues. On the one hand, it could be useful to build up a modified structure of the TPB model, incorporating risk perception and food technophobia among general and specific-product attitudes in order to gain insights into supplement-taking behaviour. On the other, a greater effort is needed to make more thorough information available on the proper use of supplements. Indeed, it has been observed that the propensity to consume dietary supplements is more commonly found among young people who are presumably also the category that has less need of supplements. This paradox, that people who least seem to need supplements are most likely to use them, has been called in the literature *"the inverse supplement hypothesis"* (KIRK *et al.*, 1999). It seems particularly true in the more affluent Western countries, like Italy, where a healthy and balanced diet should be adequate to ensure intake of all the main nutrients.

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