

# Food semantics on pro-anorexia websites in Italy

## *Semantica degli alimenti nei siti pro-ana in Italia*

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**SUMMARY. Introduction.** The term pro-ana (pro-anorexia) means the spread of restrictive eating behaviors and anorectic advices in virtual spaces written by teenagers. The purpose of this pilot study consists in a qualitative and quantitative analysis of foods contained in a linguistic *corpus* made up of users' comments on pro-ana websites. **Method.** The *corpus* of pro-ana websites was analyzed through the T2K tool based on word-frequency processing. **Results.** The results show conversations regarding beverages, products of vegetable origin (fruit, vegetables) and low-calorie foods, with a tendency to limit the fear linked to the choice of high-calorie foods through reassuring and reconcilable language labels ("light", "sugar free"). **Conclusions.** These findings specify the food semantics on pro-ana websites associated to an anorectic vocabulary with restrictive diets. The results could be used to characterize the most common food as risk factors within the eating disorders framework.

**KEY WORDS:** pro-ana, anorexia, language, food.

**RIASSUNTO. Scopo.** Con il termine "pro-ana" (pro-anoressia) s'intende la diffusione di comportamenti alimentari restrittivi e consigli anoressizzanti in spazi virtuali gestiti da adolescenti. Lo studio si pone lo scopo di analizzare gli aspetti qualitativi e quantitativi degli alimenti in un corpus linguistico costituito dai commenti degli utenti di siti pro-ana. **Metodo.** Il corpus di siti web pro-ana è stato indagato tramite un'analisi delle frequenze d'uso delle parole (T2K). **Risultati.** Dai risultati emergono conversazioni principalmente riguardanti le bevande, i prodotti di origine vegetale (frutta, verdura) e ipocalorici, con una tendenza a contenere il timore legato alla scelta di cibi ipercalorici attraverso etichette linguistiche rassicuranti e conciliabili ("light", "senza zucchero") con una dieta restrittiva. **Discussione.** I risultati ottenuti mostrano la specificità della semantica alimentare associata a un "linguaggio pro-ana" legato a diete restrittive condivise nelle comunità virtuali.

**PAROLE CHIAVE:** pro-ana, anoressia, linguaggio, cibo.

## INTRODUCTION

In the last twenty years, eating disorders have assumed the characteristics of a real emergency for the mental health of adolescents and young adults<sup>1</sup>, representing the second leading cause of death within the youth population<sup>2</sup>. Specifically, anorexia nervosa (AN) is characterized by a severe weight loss that can lead to death, accompanied by a rejection of food, a distortion of one's physical appearance with concerns about one's body weight, sense of failure, shame and tendency to control<sup>3,4</sup>. In Italy, an increased incidence and prevalence of AN has also led to a greater spread of pro-anorexia sites (*pro-ana*) since the early years of the new century<sup>5</sup>.

The pro-ana phenomenon is constituted by the establishment of virtual spaces (blogs, forums, personal journals) managed by communities of adolescents, especially females, who exchange information aimed at emphasizing and enhancing restrictive behaviors to achieve weight loss through vomiting, drugs, diets and anorectic lifestyles<sup>5,6</sup>. Research has shown that the use of these sites leads to a deterioration in

the quality of a user's life, through a decrease in self-esteem, an increase in dissatisfaction and an alteration of bodily perception<sup>7,8</sup>. Alternatively, the spread of this phenomenon is linked to the role of these shared virtual spaces in the emotional support of individuals with a poor social network<sup>9</sup>. These virtual spaces promote in their users a greater sense of control over their eating disorders<sup>10</sup>, constituting a rudimentary attempt at self-care<sup>11</sup>.

In particular, specific modalities appear in the dietary and food choices of this clinical population, characterized by the restriction of food intake despite malnutrition. Significant concerns and attentional biases have been identified during the presentation of food stimuli in AN patients<sup>12-16</sup>. At a neuro-functional level, limbic and cortical dysfunctions in brain circuits related to reward and control have been identified in patients with AN<sup>17</sup>, with the different processing of food and its caloric content compared to healthy individuals. A conflict between desire for food and concern for thinness is also highlighted<sup>12,18,19</sup>. From a nutritional point of view, studies show a significant reduction in the consumption of animal proteins,

lactoproteins, vegetable proteins, carbohydrates and fats in patients with AN compared to the control group, with a modulation of neurotransmission mechanisms<sup>20</sup>. In particular, the reduction of energy food consumption already appears evident starting from the year preceding the onset of AN<sup>21</sup>. Considering 1) the limited studies on the food diaries of AN patients with 2) the poor accuracy of the reported data and 3) the use of structured methods with prearranged checklists of foods based on researcher decision<sup>20,22</sup>, the present study aims to characterize the food vocabulary used spontaneously by pro-ana blog users in Italy, identifying specific semantics associated with restrictive and anorectic behavior.

## METHODS

Between January and May 2015, 10 pro-ana sites were selected through cascade sampling<sup>23</sup> based on Google results (keyword entered “pro anorexia”). The sites were selected based on some inclusion criteria: free access to the site, the presence of recent site activity (<30 days), a minimum of 15 users, and of 10 pages per site. The linguistic database obtained (corpus) consists of the collection of comments from all the users participating in the selected sites (excluding images, nicknames and emoticons). The corpus was analyzed with T2K, an instrument for the extrapolation of knowledge from textual corpora, developed at the ItalianNLP Lab ([www.italianlp.it](http://www.italianlp.it)) of the Institute of Computational Linguistics “A. Zampolli” (CNR). According to the work-flow illustrated in Dell’Orletta et al.<sup>24</sup>, the texts of the corpus are subdivided into linguistic units on which morpho-syntactic analysis is carried out together with the extraction of named entities (names of places, of commercial products, etc.) and identification of the specific domain terminology. This procedure is particularly relevant in this pilot study, as it allows us to identify terms consisting of one or more words that occur in the corpus with a significantly different frequency distribution compared to a large corpus of journalistic texts, used as a term of comparison.

In fact, based on the “founded on contrast” terminology extraction methodology, a reference corpus was selected with which to compare the distribution of the terminology units extracted. In this experiment, the corpus “WORDS” was used, a corpus of contemporary Italian of about 3 million words representative of the common lexicon<sup>25</sup>.

In this way, monorematic terms, such as “calorie” or polyre-matic terms like “a teaspoon of oil”, emerge as specific to the domain of pro-ana sites, compared to generic terms such as “walk” or “make a phone call”.

## RESULTS

The overall corpus consists of 980 identified keywords (2290 Kb).

Table 1 shows a summary of the food corpus based on their frequency of use, subdivided by specification (qualitative dimension) and quantification of food. Table 2 details the caloric content and the macro-nutrients composition of the main foods identified.

## DISCUSSION

The pilot study pinpoints the qualitative and quantitative aspects of food in a linguistic corpus consisting of comments

Table 1. List of foods by type (with word frequency in the corpus).

Type of food	Specification	Quantification
Liquids	Green tea (42), Tea without sugar (10)	Cup of tea (22), Cup of green tea (11)
	Water (272) Coffee without sugar (8)	Cup of milk (18), Glass of milk (16) Liters of water (15), Glass of water (14) Coffee cup (11)
Fruit	Fresh fruit (22), Fresh fruits (17) Forest fruits (16), Fruit of your choice (10) Fruit juice (28), Fruit juice without sugar (21), Citrus juice (13), Lemon juice (12)	
	Mixed salad (30), Vegetable soup (17), Raw vegetables (16) Big carrots (12), Lettuce (10) Raw vegetable appetizer (7)	
Cereals	Whole wheat bread (13)	Slice of bread (15)
	Rice cakes (11), Dry hardtack type biscuits (7) Dietary fiber (13)	Whole breadsticks package (14) Whole breadsticks package for snack (7) Pasta plate (12)
Dairy products	Low-fat yoghurt (37) Light cheese (12)	
Other	Dark chocolate (14)	
		Teaspoon of sugar (9)
	Boiled egg (11)	
	Olive oil (19), Extra virgin olive oil (11)	Teaspoon of oil (26) Teaspoon of olive oil (12)

from the users of pro-ana sites through a linguistic analysis. Within the eating disorders domain, the collection of food information on pro-ana blogs represents an innovative modality which is influenced little by researchers. Indeed, compared to the limits of studies with food diaries or more structured procedures, the comments and the food details of this pilot study were collected in a (virtual) environment in which the users spontaneously write and comment, sharing dietary and culinary tips, without specific experimental conditions<sup>20,22</sup>.

In general, the data shows a specific presence of conversations regarding liquid foods with more than 400 references related to beverages: water, tea, milk and coffee. This result is coherent to the role of liquids in restrictive diets, in reducing the feeling of hunger and in giving a sense of fullness<sup>26,27</sup>. Furthermore, the excessive quantification of liquids (cup, glass) is the result of the need to share specific dietary and culinary recommendations from users in blogs<sup>5</sup>, which can lead to abnormal intake of liquids (binge drinking), such as water or non-caloric drinks, which can cause intoxication or the death of patients with AN<sup>28,29</sup>.

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Table 2. Caloric content and macronutrient composition of the main foods identified.

Food	Values per 100 grams of edible portion			
	Kcal	Protein	Lipids	Carbohydrates
Milk (*)	49	3.45	1.9	5.1
Fresh fruit (*) (**)	38	0.6	0.15	9.15
Fruit juice (*)	44.5	0.5	tr	8.2
Mixed salad (*)	16	1.45	0.15	2.3
Carrots	35	1.1	0.2	7.6
Common bread	289	8.6	0.4	66.9
Whole grain bread	224	7.5	1.3	48.5
Common breadsticks	431	12.3	13.9	68.4
Integral breadsticks	N/A	N/A	N/A	N/A
Common pasta	325	10.9	1.4	71.7
Rice cakes	N/A	N/A	N/A	N/A
Wheat bran	206	8.2	14.1	5.5
Dry hardtack type biscuits	408	11.3	6	82.3
Light yoghurt	36	3.3	0.9	4
Light cheese	179	9.2	14.5	3.1
Dark chocolate	515	6.6	33.6	49.7
Sugar	392	0	0	104.5
Egg	128	12.4	8.7	tr
Olive oil	899	0	99.9	0
Extra virgin olive oil	899	0	99.9	0
Vegetable soup	N/A	N/A	N/A	N/A

(\*) Average comparing the most and least caloric food of the same category; (\*\*) Excluding dried fruit and chestnuts; "N/A" not available data; "tr" traces. Source: INRAN - Istituto nazionale di ricerca per gli alimenti e la nutrizione (Italy).

Specifically, both green tea and coffee contain 1,3,7-trimethylxanthine (caffeine or theine), which can influence body weight<sup>30,31</sup>. Higher caffeine consumption seems to be associated with many psychiatric disorders, including bulimia and anorexia nervosa<sup>32,33</sup>. It should be noted that, in AN, caffeine consumption increases significantly (from 9 to 19 years) the typical age range that characterizes the users of pro-ana blogs<sup>5,6,34</sup>.

From a different prospective, the results underline the lack of conversations regarding foods of strictly animal origin (meat or fish) and a choice more geared to foods of vegetable origin (fruit, vegetables, cereals). Considering foods

with higher frequency of use (>20), we particularly find foods with low caloric value (except for "a teaspoon of oil"), such as water or green tea, fresh fruit or juice, salad and low-fat yoghurt. This food choice, also observed in clinical cases of AN, is the result of a reduction in the preference expressed for high-calorie foods associated with a greater use of low-calorie foods<sup>35</sup> which determines a significant reduction in energy supply from food consumption<sup>21</sup>. At the brain level, it has been suggested that this choice tendency may be the consequence of a maladaptive response mechanism to high calorie foods caused by a dysfunction in somatosensory and interoceptive processing by the insula and the amygdala<sup>36,37</sup>.

Consistent with this, a certain aversion on the part of patients with eating disorders to foods with a high protein content<sup>38</sup> (meat, fish, milk) has been documented. However, considering different ways of recording foods taken under specific experimental conditions or through self-reports<sup>39</sup>, conflicting results emerge regarding the reduced protein consumption in AN patients<sup>40-43</sup>. Furthermore, the same aversion can be noted in patients with AN towards dietary recommendations (consistent with the recommended daily allowance - RDA) for states of deficiency in vitamin D and B12, calcium, folate, zinc, magnesium and copper<sup>44</sup>.

Curiously, the only foods of animal origin (dairy products) are characterized by linguistic labels ("low-fat", "light") due to the orientation in the choice of food towards a type of product with reduced fat content. This result is in line with what is reported in literature that shows a reluctance towards the fat consumption in patients suffering with AN, already a year before the disorder onset<sup>21</sup>.

Specifically, sugar is an alarmingly high-calorie element, to be limited in the diet as evidenced by the selection of liquid products "without sugar" (tea, coffee, juice). In fact, considering the desirability of foods with high energy content (with sugar) in the general population, such foods would suffer from a conflict between the desire for reward and the concern for one's own weight, producing fear within the individual<sup>12,18,19</sup> exorcised by more reassuring and reconcilable linguistic labels (e.g. 39 references to "sugar-free" foods) with a restrictive diet.

## CONCLUSIONS

In conclusion, the research places a new light on specific food semantics that could constitute risk indicators for the evolution of a restrictive eating behavior disorder, guiding parents and health professionals towards a timely clinical-psychiatric analysis of the adolescent/pro-ana blog user by facilitating the prevention of anorexia nervosa in virtual communities and avoiding chronicization of the disorder over time. Further studies in computational linguistics (e.g. sentiment analysis) are needed on a larger data base to have a more detailed view of this phenomenon in Italy.

This pilot study doesn't claim to be exhaustive, but it aims to identify a specific food semantic to design new screening tools. The results could be used to characterize the most common food as risk factors within the eating disorders framework.

*Conflict of interests:* the authors have no conflict of interests to declare.

## REFERENCES

- Lingiardi V, Gazzillo F. La personalità e i suoi disturbi: valutazione clinica e diagnosi al servizio del trattamento. Milano: Raffaello Cortina Editore, 2014.
- World Health Organization (WHO), 2017.
- American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-IV-TR (4th ed). Washington, DC: American Psychiatric Publishing, 2000.
- Lingiardi V, Del Corno F. PDM – Manuale Diagnostico Psicodinamico. Presentazione dell'edizione italiana. Milano: Raffaello Cortina Editore, 2008.
- Giovannini A. Ricerca sul fenomeno pro Ana. 2005.
- Dias K. The ana sanctuary: women's pro-anorexia. Narratives in cyberspace. *Journal of International Women's Studies* 2003; 4: 31-45.
- Fernandez S, Pritchard M. Relationships between self-esteem, media influence and drive for thinness. *Eat Behav* 2012; 321-5.
- Fox N, Ward K, O'Rourke A. Pro-anorexia, weight-loss drugs and the internet: an "anti-recovery" explanatory model of anorexia. *Sociol Health Illn* 2005; 944-71.
- Juarascio A, Shoaib A, Timko AC. Pro-eating disorder communities on social networking sites: a content analysis. *Eat Disord* 2010; 18: 393-407.
- Lyons EJ, Mehl MR, Pennabaker JW. Pro-anorexics and recovering anorexics differ in their linguistic internet self-presentation. *J Psychosom Res* 2006; 60: 253-6.
- Wooldridge T. The enigma of ana: a psychoanalytic exploration of pro-anorexia internet forums. *J Infant Child Adolesc Psychother* 2014; 13: 202-16.
- Cowdrey FA, Stewart A, Roberts J, Park RJ. Rumination and modes of processing around meal times in women with anorexia nervosa: qualitative and quantitative results from a pilot study. *Eur Eat Disord Rev* 2013; 21: 411-9.
- Park RJ, Dunn BD, Barnard PJ. Schematic models and modes of mind in anorexia nervosa I: a novel process account. *Int J Cogn Ther* 2011; 4: 415-37.
- Park RJ, Dunn BD, Barnard PJ. Schematic models and modes of mind in anorexia nervosa II: implications for treatment and course. *Int J Cogn Ther* 2012; 5: 86-98.
- Aspen V, Darcy AM, Lock J. A review of attention biases in women with eating disorders. *Cogn Emot* 2013; 27: 820-38.
- Brooks SJ, Prince A, Stahl D, Campbell IC, Treasure J. A systematic review and meta-analysis of cognitive bias to food stimuli in people with disordered eating behavior. *Clin Psychol Rev* 2011; 31: 37-51.
- Scaife JC, Godier LR, Reinecke A, Harmer CJ, Park RJ. Differential activation of the frontal pole to high vs low calorie foods: the neural basis of food preference in anorexia nervosa? *Psych Res* 2016; 258: 44-53.
- Berridge KC, Robinson TE, Aldridge JW. Dissecting components of reward: 'liking', 'wanting', and learning. *Curr Opin Pharmacol* 2009; 9: 65-73.
- Zhang X, Paule MG, Newport GD, et al. A minimally invasive, translational biomarker of ketamine-induced neuronal death in rats: micropet imaging using 18F-annexin V. *Toxicol Sci* 2009; 111: 355-61.
- Segura-García C, De Fazio P, Sinopoli F, De Masi R, Brambilla F. Food choice in disorders of eating behavior: correlations with the psychopathological aspects of the diseases. *Compr Psychiatry* 2014; 55: 1203-11.
- Affenito SG, Dohm FA, Crawford PB, Daniels SR, Striegel-Moore RH. Macronutrient intake in anorexia nervosa: the national heart, lung, and blood institute growth and health study. *J Pediatr* 2002; 141: 701-5.
- Trabulsi J, Schoeller DA. Evaluation of dietary assessment instruments against doubly labeled water, a biomarker of habitual energy intake. *Am J Physiol Endocrinol Metabol* 2001; 281: e891-9.
- Lucisano P, Salerni A. Metodologia della ricerca in educazione e formazione. Roma: Carocci Editore, 2002.
- Dell'Orletta F, Venturi G, Cimino A, Montemagni S. T2K<sup>2</sup>: a system for automatically extracting and organizing knowledge from texts. Reykjavik, Iceland: in Proceedings of 9th Edition of International Conference on Language Resources and Evaluation (LREC 2014) 2014; May: 26-31. (<https://bit.ly/33oeQHo>).
- Marinelli R, Biagini L, Bindi R, et al. The italian PAROLE corpus: an overview. *Computational Linguistics in Pisa, XVI-XVII, IEPI, I* 2003; 401-21.
- Abraham SF, Hart S, Luscombe G, Russell J. Fluid intake, personality and behaviour in patients with eating disorders. *Eat Weight Disord* 2006; 11: e30-4.
- Hart S, Abraham S, Franklin RC, Russell J. The reasons why eating disorder patients drink. *Eur Eat Disord Rev* 2011; 19: 121-8.
- Jacquin P, Ouvre O, Alvin P. Fatal water intoxication in a young patient with anorexia nervosa. *J Adolesc Health* 1992; 13: 631-3.
- Santonastaso P, Sala A, Favaro A. Water intoxication in anorexia nervosa: a case report. *Int J Eat Disord* 1998; 24: 439-42.
- Hase T, Komine Y, Meguro S, Takeda Y, Takahashi H, Matsui Y. Anti-obesity effects of tea catechins in humans. *J Oleo Sci* 2001; 50: 599-605.
- Chantre P, Lairon D. Recent findings of green tea extract AR25 (Exolise) and its activity for the treatment of obesity. *Phytomedicine* 2002; 9: 3-8.
- Ciapparelli A, Paggini R, Carmassi C, et al. Patterns of caffeine consumption in psychiatric patients. An Italian study. *Eur Psychiatry* 2010; 25: 230-5.
- Bergin JE, Kendler KS. Common psychiatric disorders and caffeine use, tolerance, and withdrawal: an examination of shared genetic and environmental effects. *Twin Res Hum Genet* 2012; 15: 473-82.
- Striegel-Moore RH, Franko DL, Thompson D, Barton B, Schreiber GB, Daniels SR. Caffeine intake in eating disorders. *Int J Eat Disord* 2006; 39: 162-5.
- Stoner SA, Fedoroff IC, Andersen AE, Rolls BJ. Food preference and desire to eat in anorexia and bulimia nervosa. *Int J Eat Disord* 1986; 19: 13-22.
- Holsen LM, Lawson EA, Blum J, et al. Food motivation circuitry hypoactivation related to hedonic and nonhedonic aspects of hunger and satiety in women with active anorexia nervosa and weight-restored women with anorexia nervosa. *J Psychiatry Neurosci* 2012; 37: 322.
- Joos AA, Saum B, van Elst LT, et al. Amygdala hyperreactivity in restrictive anorexia nervosa. *Psychiatry Res Neuroimaging* 2011; 191: 189-95.
- Vaz FJ, Alcaina T, Guisado JA. Food aversions in eating disorders. *Int J Food Sci Nutr* 1998; 49: 181-6.
- Forbush KT, Hunt TK. Characterization of eating patterns among individuals with eating disorders: what is the state of the plate? *Physiol Behav* 2014; 134: 92-109.
- Crisp AH. Some aspects of the evolution, presentation and follow-up of anorexia nervosa. *Proc R Soc Med* 1965; 58: 814-20.
- Hurst PS, Lacey LH, Crisp AH. Teeth, vomiting and diet: a study of the dental characteristics of seventeen anorexia nervosa patients. *Postgrad Med J* 1977; 53: 298-305.
- Beumont PJV, Chambers TL, Rouse L, Abraham SF. The diet composition and nutritional knowledge of patients with anorexia nervosa. *J Hum Nutr* 1981; 35: 265-73.
- Huse DM, Lucas AR. Dietary patterns in anorexia nervosa. *Am J Clin Nutr* 1984; 40: 251-4.
- Hadigan CM, Anderson EJ, Miller KK, et al. Assessment of macronutrient and micronutrient intake in women with anorexia nervosa. *Int J Eat Disord* 2000; 28: 284-92.