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Dispositional optimism is associated with weight status, eating behavior and eating disorders in a general population-based study

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Abbreviations: BMI, Body Mass Index; CES-D, Center for Epidemiologic Studies Depression scale; CI, Confidence Interval, CU, Consumption Unit; EDs, eating disorders; LOT-R, Life Orientation Test-Revised; mPNNS-GS, modified Programme National Nutrition Santé – Guideline Score; OR, Odds Ratio, SCOFF, Sick-Control-One-Fat-Food Questionnaire

1 **Abstract**

2 **Objective:** The objective of this cross-sectional study was to assess whether optimism is
3 associated with body mass index (BMI), eating behavior and eating disorders (EDs) in a
4 population-based study.

5 **Design:** In 2016, a total of 32,805 participants aged ≥ 18 years from the NutriNet-Santé cohort
6 completed the Life Orientation Test-Revised, assessing dispositional optimism. Height and
7 weight were self-reported. Eating behavior was assessed with the revised 21-item Three-Factor
8 Eating Questionnaire. Risk of EDs was evaluated with the Sick-Control-One-Fat-Food
9 Questionnaire. Linear and Logistic regression was used to analyze the association between
10 optimism, BMI categories, eating behavior and ED risk, controlling for sociodemographic,
11 lifestyle and depressive symptom characteristics.

12 **Results:** Our sample was composed of 73.5% women, and the mean age was 55.39 ± 13.70
13 years. More optimistic participants were less likely to be underweight (OR = 0.82; 95% CI:
14 0.75, 0.89), or obese, particularly class III obese (BMI $\geq 40\text{kg/m}^2$) (OR = 0.69; 95% CI: 0.56,
15 0.84) compared with less optimistic individuals. Optimism was negatively associated with
16 cognitive restraint ($\beta = -0.07$; 95% CI: -0.08; -0.06), emotional eating ($\beta = -0.17$; 95% CI: -0.19,
17 -0.16) and uncontrolled eating ($\beta = -0.10$; 95% CI: -0.11, -0.09). In addition, more optimistic
18 participants had a lower risk of EDs (OR = 0.60; 95% CI: 0.56, 0.64).

19 **Conclusion:** Our findings showed that optimism was associated with weight status, eating
20 behavior and risk of EDs in both women and men. The causal structure of the underlying
21 observed association remains unclear and should be further investigated.

22

23 **Keywords:** Dispositional optimism, weight, eating behavior, eating disorders, psychological
24 determinants, nutrition

1 **Background**

2 Dispositional optimism is a psychological trait that can be defined as the general expectation
3 that good things, rather than bad things, will occur in one's future (1). It has been linked to
4 health behaviors, better emotional well-being and better health outcomes (2), in particular lower
5 risk of cardiovascular diseases (3) healthier aging (4) and lower mortality (3). It has been argued
6 that public health prevention approaches focusing on building competencies, such as rearing
7 optimism, could be more effective than focusing on correcting weaknesses, such as
8 discouraging emotional eating or impulsivity (5). Although optimism remains relatively stable
9 during one's lifetime (2), it has been demonstrated in randomized controlled trials that it can be
10 learned (6), leading to suggestions for novel interventions to combat chronic diseases.

11 Overweight and obesity represent major public health issues given their association with
12 coronary heart disease, non-insulin-dependent diabetes and certain types of cancer. These
13 chronic conditions are determined by numerous factors among which psychological
14 characteristics can be found (7). A few studies investigated the association between
15 dispositional optimism and weight status in longitudinal (10) and cross-sectional (9) studies,
16 suggesting a negative relationships. However, these associations were found in women only
17 (8,9). Likewise, results from bivariate analyses indicated a negative association in women
18 (3,10), and no association in men (11). These associations observed in women could be
19 explained by a more proactive approach to health promotion in optimistic individuals or a better
20 coping profile (2,12). Given the limited number of studies investigating optimism and weight
21 status, and the conflicting results, there is a clear need for large-scale studies, including both
22 genders. Such studies should take into account potential confounders, and in particular
23 psychological distress (13), which has not been considered in previous research. It is also of
24 interest to investigate potential differential associations between dispositional optimism and
25 specific weight status categories. Negative emotions have been associated with either increased
26 or decreased food intake (14). We can therefore hypothesize that optimistic individuals, who

1 have been found to better cope with negative emotions (12), are less at risk for over- but also
2 under-weight.

3 Eating behaviors, and particularly cognitive restraint (CR), emotional eating (EE) and
4 uncontrolled eating (UE), could be involved in weight regulation, and therefore play an
5 important role in overweight and obesity. While the role of cognitive restraint is unclear and
6 could be either positive or negative (15), uncontrolled eating and emotional eating has been
7 positively associated with obesity (15,16). Some psychological characteristics are considered
8 risk factors for these eating behaviors (17,18), yet, to our knowledge, only one study has
9 examined the link between optimism and emotional eating (19). Results showed that optimism
10 was correlated with emotional eating, but the multivariable regressions failed to confirm this
11 association (19).

12 EDs are associated with physical and psychological comorbidities (20). They are particularly
13 prevalent among women, adolescents or young adults (21) but are often poorly detected in the
14 general population, which results in delayed treatment (22,23). It is important to identify the
15 different factors associated with EDs for better prevention options. In the literature, only one
16 cross-sectional study carried out among female students has focused on dispositional optimism
17 and binge eating, and has found a negative association (24). Other bivariate data available
18 between optimism and EDs indicated contrasted results (19,25). In addition, these studies have
19 been carried out among specific populations such as athletes or undergraduate students, with
20 no use of confounders.

21 The aim of this cross-sectional study was to explore for the first time the relationship between
22 dispositional optimism, weight status, eating behaviors and ED risk in a large population-based
23 sample, taking into account socio-demographic, lifestyle and depressive symptom
24 characteristics.

1 **Methods**

2 *Study population and design*

3 This study was conducted within the NutriNet-Santé cohort, a large ongoing web-based cohort
4 study, launched in France in May 2009. The rationale, design and methods have been described
5 elsewhere (26). It aims to explore the relationship between health and nutrition, and the
6 determinants of eating behavior and nutritional status. Participants are adult volunteers
7 (age \geq 18 years) from the general French population. At baseline, participants complete a set of
8 self-report web-based questionnaires to assess anthropometric characteristics, socio-economic
9 conditions, dietary intakes, health status, physical activity and lifestyle. They complete this set
10 of questionnaires every year after inclusion. This set of web-based questionnaires has been
11 validated against traditional methods (27–29). Each month, participants are asked to complete
12 optional questionnaires related to eating behavior determinants, and specific health-related
13 outcomes.

14 The NutriNet-Santé study was conducted in accordance with the Declaration of Helsinki, and
15 all procedures were approved by the Institutional Review Board of the French Institute for
16 Health and Medical Research (IRB Inserm n° 0000388FWA00005831) and the *Commission*
17 *Nationale Informatique et Libertés* (CNIL n° 908450 and n° 909216). Electronic informed
18 consent was obtained from all participants. The study was registered at clinicaltrials.gov as
19 #NCT03335644.

20

21 *Assessment of optimism*

22 Dispositional optimism was measured with the French Version (30) of the Life Orientation
23 Test-Revised (LOT-R) (31), administered between September and December 2016 in the
24 NutriNet-Santé Study. This questionnaire was optional, and no reminders were sent. The LOT-
25 R is a self-report questionnaire composed of 6 items: 3 positively worded (e.g. “I’m always
26 optimistic about my future”) and 3 negatively worded (e.g. “I hardly ever expect things to go

1 my way”). Each item is scored on a 5-point Likert scale ranging from 0 (strongly disagree) to
2 4 (strongly agree). The scoring for the negatively worded items was reversed and then added to
3 the score of the other items. The resulting score (ranging from 0 to 24) was divided by the total
4 number of items, leading to a final score ranging from 0 (least optimistic) to 4 (most optimistic).
5 Following the recommendation (32), we modelled the LOT-R score on a unidimensional
6 continuous scale. In our population, the LOT-R displayed good internal consistency
7 (Cronbach’s $\alpha = 0.84$).

8

9 *Assessment of weight status*

10 Self-reported height and weight are collected each year using a web-based questionnaire which
11 has been tested and validated against traditional paper-and-pencil questionnaires (28), and
12 against measured weight and height by trained staff (33). Since weight and height are reported
13 annually, we used the data provided closest to the date of completion of the LOT-R. Body Mass
14 Index (BMI) (kg/m^2) was calculated as the ratio of weight to squared height and classified into
15 6 categories, according to the WHO reference values (34): underweight ($\text{BMI} < 18.5 \text{ kg}/\text{m}^2$),
16 normal weight ($18.5 \leq \text{BMI} < 25.0 \text{ kg}/\text{m}^2$), overweight (excluding obesity) ($25.0 \leq \text{BMI} < 30.0$
17 kg/m^2), obese class I ($30.0 \leq \text{BMI} < 35.0 \text{ kg}/\text{m}^2$), obese class II ($35.0 \leq \text{BMI} < 40.0 \text{ kg}/\text{m}^2$),
18 obese class III ($\text{BMI} \geq 40.0 \text{ kg}/\text{m}^2$).

19

20 *Assessment of eating behaviors*

21 Eating behaviors were measured using the French version of the revised 21-item Three-Factor
22 Eating Questionnaire (TFEQ-R21) (35). The self-report questionnaire was administered
23 between March and November 2017 in the NutriNet-Santé study. The TFEQ-R21 covers 3
24 aspects of eating behavior: cognitive restraint (6 items) which refers to the control over food
25 intake to influence body weight and body shape, emotional eating (6 items) which refers to

1 overeating during negative mood state, and uncontrolled eating (9 items) which refers to
2 difficulties in the regulation of eating (36). To take into account individuals with specific diets,
3 the following item “When I smell a sizzling steak or a juicy piece of meat, I find it very difficult
4 to keep from eating, even if I have just finished a meal.” Was modified into “When I smell a
5 delicious food, I find it very difficult to keep from eating, even if I have just finished a meal.”
6 Each item is scored on a 4-point response scale, from “definitely true” to “definitely false”.
7 Each subscale score was calculated as a mean of all items, so that the score ranges from 1 to 4.
8 In our population, the TFEQ-R21 displayed a good internal consistency. Cronbach’s α were the
9 following: $\alpha_{CR} = 0.77$, $\alpha_{EE} = 0.94$ and $\alpha_{UE} = 0.87$.

10

11 *Assessment of risk of eating disorders (EDs)*

12 EDs are defined as “an illness in which people experience severe disturbance in eating
13 behaviors and related thoughts and emotions” (37). EDs can be identified using the self-report
14 Sick-Control-One-Fat-Food Questionnaire (SCOFF) (38). The French version of the SCOFF
15 questionnaire (38) was administered between April and October 2017. The SCOFF has good
16 sensitivity and specificity regarding identification of EDs risk (38–40). The British *National*
17 *Institute for Health and Care Excellence guidelines* suggests using this questionnaire as a
18 screening tool for EDs in primary care (41). The SCOFF includes 5 dichotomous questions
19 (Yes=1 / No=0). An overall score ≥ 2 indicates ED risk, with a sensitivity of 88.2% and a
20 specificity of 92.5% (40). The Expali algorithm was used to distinguish the different ED
21 categories (42). The algorithm takes into account each SCOFF response and the individual’s
22 BMI to classify participants in four broad categories. These categories were based on the
23 *Diagnostic and Statistical Manual of Mental Disorders, Fifth Revision* (DSM-V) ED
24 categories, namely 1) restrictive disorders category including anorexia nervosa, restrictive food
25 intake disorder and atypical anorexia nervosa, 2) bulimic disorders category including bulimia

1 nervosa or bulimia nervosa of low frequency or duration, 3) hyperphagic disorders category
2 including binge-eating disorders and binge-eating disorder of low frequency or duration, 4)
3 other eating disorders category including purging disorder, and night eating syndrome and any
4 other EDs.

5

6 *Covariates*

7 Data on potential confounders of the association between optimism, BMI, eating behaviors and
8 the risk of EDs were collected. The latest data available prior to the date of completion of the
9 LOT-R were selected. Each year after inclusion, participants provide information about age
10 (years), gender (men, women), educational level (primary, secondary, undergraduate and
11 postgraduate), occupational status (unemployed, student, self-employed and farmer, employee
12 and manual worker, intermediate profession, managerial staff and intellectual profession, and
13 retired), monthly income per household unit, presence of children in the household, smoking
14 status (never, former smokers and current smokers), physical activity and energy intake
15 (including alcohol). Monthly income per household unit was calculated using information about
16 income and household composition. The number of people in the household was converted into
17 a number of consumption units (CU) according to the OECD (Organization for Economic
18 Cooperation and Development) equivalence scale: one CU is attributed for the first adult in the
19 household, 0.5 for other persons aged 14 or older and 0.3 for children under 14 (43). Categories
20 of monthly income were defined as follows: < 1,200; 1,200-1,799; 1,800-2,299; 2,300-2,699;
21 2,700-3,699; and > 3,700 euros per household unit as well as “unwilling to answer”. Physical
22 activity was assessed with the short form of the French version of the International Physical
23 Activity Questionnaire (44). Weekly energy expenditure, expressed in Metabolic Equivalent of
24 Task in minutes per week (MET-minutes/week) was estimated and three levels of physical
25 activity were constituted: low (< 30min/day), moderate (30 - 60min/day), and high

1 (≥ 60 min/day). Energy intake (Kcal) was assessed with a set of three 24-h-dietary records which
2 participants are asked to complete every six months. Participants reported all food and
3 beverages consumed in a day, using standard measurements and/or validated photographs when
4 reporting portion sizes (45). Nutrient intakes were estimated by using the published NutriNet-
5 Santé food composition table. Mean daily food intake (in grams per day) was weighted
6 according to the day of the week (weekday or weekend). In addition, depressive
7 symptomatology was assessed with the French Version (46) of the Center for Epidemiologic
8 Studies-Depression Scale (CES-D) (47), administered between November 2017 and May 2018.
9 The CES-D is a 20-item questionnaire with items rated on a 4-point scale, with higher scores
10 indicating higher depressive symptomatology. Participants were classified according to the
11 presence of depressive symptomatology (no vs yes) using the commonly used cut-off of 16
12 across gender (47). The CES-D had a good internal consistency (Cronbach's $\alpha = 0.91$) in our
13 sample.

14

15 *Statistical analysis*

16 We used Student t-test and Chi-squared test to compare included with excluded participants.
17 Relationships between individual characteristics and optimism were described with Pearson
18 correlations for continuous variables, and Student t-test and variance analysis for categorical
19 variables. To assess the association between optimism (independent variable) and BMI
20 categories (dependent variable) we used multinomial logistic regression. Linear regression
21 models were used to assess the association between optimism (independent variable) and each
22 eating behavior subscale (dependent variable). Finally, to assess the association between
23 dispositional optimism (independent variable) and the risk of EDs (dependent variable) we used
24 binary (yes vs no) and multinomial (categories of EDs) logistic regression models. The strength
25 of all associations was determined by calculating odds ratios (ORs) for logistic regression, β -

1 coefficients for linear regression, and 95% confidence intervals (95% CI). Confounders
2 associated with optimism, BMI, eating behaviors and EDs at the $P < 0.2$ level in bivariate
3 models were retained in multivariable logistic and linear regression models. Three different
4 models were tested: Model 1: unadjusted; Model 2 adjusted for age, gender, educational level,
5 occupational status, monthly household income, presence of children in the household, smoking
6 status, physical activity, and energy intake; Model 3 adjusted for the same confounders as
7 Model 2 plus depressive symptomatology. Analyses were not stratified by gender since the
8 interactions regarding BMI ($P = 0.88$), the three eating behavior dimensions ($P_{CR} = 0.2$,
9 $P_{EE} = 0.10$, $P_{UE} = 0.42$) or risk of EDs ($P = 0.10$) were not significant. Missing data with regard
10 to confounders were handled with multiple imputations by fully conditional specification (20
11 imputed data sets). All tests of statistical significance were 2-sided, and significance was set at
12 5%. Statistical analyses were performed using SAS version 9.4 software (SAS Institute, Inc.).

13

14 **Results**

15 *Characteristics of the sample*

16 A total of 32,805 participants of the NutriNet-Santé cohort completed the optional LOT-R
17 among the 120,559 who received it. From the group of responders, 78 participants were
18 excluded because they presented an acquiescence bias in the LOT-R (agreeing to all questions
19 without consideration of the reverse items) and 1,912 were excluded because they did not
20 provide anthropometric data, leading to a sample of 30,815 participants (22,650 women and
21 8,165 men) with complete optimism and anthropometric data. Among these 30,815 participants,
22 26,249 (19,113 women and 7,136 men) also completed the TFEQ-R21 questionnaire, and
23 28,018 (20,474 women and 7,544 men) completed the SCOFF questionnaire. Compared with
24 excluded participants (those who completed the LOT-R but presented an acquiescence bias or
25 had no anthropometric data), the 30,815 included participants were older (55.1 ± 13.8 years for
26 included participants vs. 51.6 ± 15.7 for excluded participants, $P < 0.0001$), included a higher

1 proportion of men (26.5% vs. 22.6%, $P < 0.0001$), and a higher proportion of individuals with
2 university education (67.8% vs. 64.5%, $P = 0.022$). In addition, the level of optimism was
3 higher among included participants (2.52 ± 0.65 vs. 2.45 ± 0.64 , $P < 0.0001$).

4 **Table 1** shows individual characteristics of participants and their associations with dispositional
5 optimism. Overall, the mean score for optimism was 2.52 ± 0.65 . Optimism was higher in men,
6 in older individuals, in participants with a higher level of education, in self-employed
7 participants, farmers, managerial staff, and those with intellectual professions, in individuals
8 with higher monthly income, in individuals with children in the household, in former smokers,
9 in participants with a higher level of physical activity and in participants with a higher energy
10 intake (all $P < 0.0001$). In addition, optimism was higher in participants with no depressive
11 symptoms ($P < 0.0001$).

12

13 *Association between optimism and BMI categories*

14 **Table 2** shows the results of the logistic regression models between optimism and BMI
15 categories. More optimistic participants were less likely to be overweight or obese, with the
16 lowest OR observed for the class III obesity category (models 1 and 2). In model 3, with an
17 additional adjustment for depressive symptomatology, all associations remained significant
18 apart from the overweight category. In addition, more optimistic individuals were less likely to
19 be underweight (all models).

20

21 *Association between optimism and eating behavior*

22 **Table 3** shows the results of the linear regressions models between optimism and eating
23 behaviors. Optimism was negatively associated with the three aspects of eating behavior,
24 namely cognitive restraint, emotional eating and uncontrolled eating (all models). The strongest
25 associations were found for emotional eating.

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Association between optimism and risk of EDs

Table 4 shows the results of the logistic regression models between optimism and the risk of EDs. More optimistic participants were less likely to have a risk of EDs overall and of each category of EDs specifically (all models). The strongest association was found for restrictive disorders.

Discussion

This large population-based study is, to our knowledge, the first to investigate the association of optimism with BMI, eating behaviors and EDs, respectively, taking socio-demographic, lifestyle and depressive symptomatology factors into account. Our results indicated that more optimistic individuals were less likely to be underweight or obese. In addition, more optimistic individuals showed less cognitive restraint, emotional eating or uncontrolled eating. They were also less likely to have EDs, and in particular restrictive disorders.

These results therefore may suggest a beneficial influence of optimism on weight status, eating behavior and EDs. However, given the cross-sectional design of the study, we cannot rule out the possibility that BMI, eating behaviors or EDs could themselves influence the optimistic level of individuals. Moreover, those three outcomes, as well as dispositional optimism, could be due to common factors. Indeed, dispositional optimism, BMI, eating behaviors and EDs are associated with genetic (34,35,48,49) socio-cultural (34,48,50,51). and socio-economic (34,52–54) factors.

Level of optimism, according to socio-demographic, lifestyle and depressive symptomatology characteristics

1 The overall optimism score observed in our study is consistent with previous results in the
2 literature (55,56). In addition, our descriptive analyses are consistent with previous data
3 indicating higher levels of optimism in individuals with a higher level of education (3,10),
4 income (3,10) and physical activity (3,10,11). However, optimism was slightly higher in former
5 smokers, in contrast with previous data (3,10). We also found a higher level of optimism in
6 men, managerial staff and intellectual professions and in individuals with children in the
7 household. Optimism was positively correlated with age and dietary energy. Finally, optimistic
8 individuals had a lower level of depressive symptoms, consistent with data in the literature (10).
9

10 *Association between optimism and BMI categories*

11 We demonstrated that more optimistic individuals (men and women) were less likely to be
12 obese, particularly regarding class III obesity. Our results are consistent with previous cross-
13 sectional (9) and longitudinal (8) studies that showed lower BMI in optimistic women compared
14 with less optimistic ones. However, no association was observed in men in these two studies
15 (8,9). Further, descriptive data showed lower BMI in optimistic women (3,10), while no
16 associations were found in men (11). Our study does not support the gender-specific association
17 suggested in the literature, indicating that mechanisms in women and men may be similar. In
18 addition, to our knowledge, no other studies have reported that optimistic participants were less
19 likely to be underweight compared with their non-optimistic counterparts.

20 The inverse association found between optimism and BMI categories, and more specifically the
21 associations observed in the case of obesity, can be explained by a more proactive approach to
22 health promotion in optimistic individuals (57). Optimistic individuals have been shown to be
23 more likely to display healthier behaviors (31,57) such as smoking less (3,9), being more
24 physically active (3,11), and having a healthier diet (9,10). For example, optimists tend to have
25 a greater intake of fruit (9,58), whole grains (11,58), vegetables (9,11), berries (9), low-fat dairy

1 products (9), olive oil (59), fish (58), legumes (58), legume seeds (60), nuts (58) and soy
2 products (58,60) compared with pessimists. In addition, optimists might be more skilled at
3 acknowledging a situation and modifying their beliefs and behaviors in consequence (61). For
4 instance, optimists might be more capable of noticing an increase in their weight, and changing
5 their dietary habits accordingly.

6 Compared to pessimists, optimists also show a better profile of emotional responses to adversity
7 due to more effective coping reactions (2,12). For instance, they are less affected by distress
8 and they tend to have more positive emotions (57). These characteristics may lead to healthier
9 choices and less physiological strains (62,63), resulting in better health (57). Negative emotions
10 have also been associated with either increased or decreased food intake (14), which may result
11 in either over- or under-weight. This greater coping profile in optimistic individuals (2,12) may
12 therefore protect them from developing weight issues, which can either be an under- or over-
13 weight.

14 Other studies have suggested the reverse that is, individuals with higher BMI may also, as a
15 consequence, be less optimistic (64) Potential explanation involves higher BMI being
16 associated with a higher body image dissatisfaction (65), which has itself been associated with
17 optimism (66).

18 *Association between optimism and eating behaviors*

19 Our analysis showed a negative association between dispositional optimism and cognitive
20 restraint, emotional eating and uncontrolled eating. These results are in accordance with
21 previous data indicating a negative correlations between emotional eating and optimism, though
22 multivariate regression models did not verify this association (19). The small sample size of the
23 aforementioned study can potentially explain the null results of these multivariable models.
24 Optimists tend to have more positive emotion than pessimists one (57) which might explain
25 their lower emotional eating level. Optimists also demonstrate greater social support (67), and

1 better coping reactions, leading to a better profile of emotional response to adversity (2,12) and
2 therefore lower emotional eating.

3 Optimism has been positively associated with self-esteem (68,69) , and self-esteem is itself
4 negatively associated with body-weight dissatisfaction (70). It could therefore be hypothesized
5 that optimists are less dissatisfied with their body weight, and therefore feel less urge to control
6 their weight through cognitive restraint.

7 Similarly, we showed a negative association between optimism and uncontrolled eating.

8 Optimistic individuals may lose less control over eating when feeling hungry or when exposed
9 to external stimuli, which characterize uncontrolled eating (36).

10 However, we cannot exclude the possibility that optimism can itself be affected by eating
11 behaviors.

12

13 *Association between optimism and EDs*

14 Our results showed a negative association between dispositional optimism and EDs overall, in
15 agreement with a previous study conducted with young adults (19). However, other studies
16 conducted in male (71) and female (25) college athletes observed no associations. In addition,
17 we found that optimism was negatively associated with every type of EDs (restrictive, bulimic,
18 hyperphagic and other). Previous data demonstrated that dispositional optimism was associated
19 with a reduced likelihood of binge eating in African American women, while no association
20 was observed in Caucasian women (24). Other studies in this domain did not find any
21 associations between optimism and binge eating (72) or bulimia nervosa (73). The null findings
22 in these studies may be due to the limited samples sizes. The lower rates of EDs, and in
23 particular bulimic and hyperphagic disorders, observed in optimistic individuals in the present
24 study may be partly explained by a lower engagement in emotional eating (19) as demonstrated

1 in the present study. In addition, anxiety, which is a risk factor for anorexia and bulimia nervosa
2 (74), has been shown to be less prevalent in optimistic individuals (75).

3 Although there are no data available, it is possible that the association goes in the opposite
4 direction, with EDs leading to lower levels of optimism.

5 As optimism can be learned, it could be a potential facilitator in the prevention of obesity and
6 EDs. Various methods are available to increase optimism (6). The Penn Resiliency Program for
7 instance (76), is a group-based intervention that teaches cognitive, behavioral and social
8 problem-solving skills. Individuals learn a variety of techniques for coping, and problem-
9 solving, including assertiveness, negotiation, decision making and relaxation. The cognitive
10 and problem-solving techniques are applied during group discussions and homework
11 assignments (77).

12

13 *Strengths and limitations*

14 One strength of this study is the large database which enabled studying a sample of individuals
15 from various socio-demographic backgrounds and of varying nutritional status, and allowed us
16 to adjust for multiple confounding factors. However, we cannot rule out the existence of
17 residual confounding due to other individual or environmental factors. The use of the Internet
18 for data collection added to the fact that all questionnaires were anonymous, minimized social
19 desirability bias and encouraged participants to deliver uncensored personal information (78).

20 In addition, levels of optimism and eating behavior were determined with the most commonly
21 used self-reported measures: the LOT-R and the TFEQ-R21, respectively. Both are validated
22 questionnaires (30,35) and demonstrated good psychometric properties in our study. Another
23 strength was the use of SCOFF to assess risk of EDs as recommended by The British National
24 Institute for health and Care Excellence guidelines (38). It is a validated tool with a good
25 sensitivity and specificity (38–40). In addition, we used the Expali algorithm, which permits

1 distinguishing among the main categories of EDs. However, the SCOFF cannot substitute for a
2 clinical diagnosis, and we cannot exclude the possibility of having a certain number of false
3 positive or false negative responses.

4 The main limitation of our study was its cross-sectional design which did not allow us to
5 conclude about the causality or the direction of the associations. Our study could also present a
6 selection bias because participants were recruited on a voluntary basis into a nutrition-focused
7 cohort. Consequently, our subjects are more likely to have higher health awareness and a higher
8 interest in nutrition compared to the global population. However, the large sample size of our
9 study provided high statistical power to detect significant differences across the different
10 categories of weight status and categories of EDs. Another limitation was the use of self-
11 reported anthropometric measures, which might have led to some misclassification. A previous
12 study showed that over-reporting of height and under-reporting of weight in self-reported data
13 led to misclassification of BMI and decreased the prevalence of obesity compared with
14 estimates based on measured data (79). Yet, standardized clinical measurements in a subsample
15 (N = 2513) of the NutriNet-Santé cohort showed good convergence with self-reported data (33).

16

17 **Conclusion**

18 This study examined the association of dispositional optimism with BMI, eating behaviors and
19 risk of EDs, respectively, in a large population-based sample of adult women and men,
20 controlling for potential confounders. We found that optimistic individuals were less likely to
21 be underweight, obese and in particular class III obese ($BMI \geq 40\text{kg/m}^2$). Optimistic individuals
22 were also less prone to show cognitive restraint, emotional eating or uncontrolled eating.
23 Finally, they were less likely to have EDs (all types) and especially restrictive disorders. As
24 optimism can be learned, these results support the hypothesis that optimism might be integrated
25 in public health strategies with regards to the prevention of obesity, eating behavior and EDs.

1 Future population-based studies are needed to confirm these findings, in particular longitudinal
2 studies that can provide evidence of causality.

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Table 1. Individual characteristics of the 30,815 participants and comparison of the LOT-R score according to these characteristics (NutriNet-Santé study, 2016).

	All (N = 30,815)	Optimism (LOT-R) ¹	P value ²
All		2.52 ± 0.65 ³	
Age (years)	55.39 ± 13.70	0.019 (0.007, 0.030) ⁴	0.0017
Gender (%)			<.0001
Men	26.93	2.56 ± 0.61	
Women	73.07	2.51 ± 0.67	
Educational level (%)			<.0001
Primary	2.19	2.40 ± 0.57	
Secondary	29.19	2.46 ± 0.64	
Undergraduate	31.17	2.53 ± 0.65	
Postgraduate	36.59	2.57 ± 0.66	
Missing data	0.86		
Occupational status (%)			<.0001
Unemployed	8.24	2.40 ± 0.73	
Student	1.07	2.43 ± 0.77	
Self-employed, farmer	1.64	2.70 ± 0.66	
Employee, manual worker	12.08	2.42 ± 0.68	
Intermediate professions	13.69	2.52 ± 0.66	
Managerial staff, intellectual profession	21.95	2.61 ± 0.65	
Retired	40.04	2.51 ± 0.60	
Missing data	1.30		
Monthly household income (%)			<.0001
<1200 €	8.42	2.39 ± 0.74	
1200 - 1799 €	18.95	2.47 ± 0.66	
1800 - 2299 €	15.03	2.49 ± 0.66	
2300 - 2699 €	10.50	2.55 ± 0.62	
2700 - 3699 €	18.82	2.60 ± 0.61	
> 3700 €	14.65	2.65 ± 0.63	
Unwilling to answer	11.91	2.46 ± 0.62	
Missing data	1.73		
Presence of children in the household (%)			<.0001
Yes	77.59	2.55 ± 0.63	
No	22.40	2.44 ± 0.71	
Missing data	0.01		
Smoking (%)			.0008
Current	9.36	2.50 ± 0.69	
Former	40.48	2.54 ± 0.63	
Never	50.15	2.51 ± 0.66	
Missing data	0.01		

Physical activity (%)			<.0001
High	38.64	2.56 ± 0.63	
Moderate	39.30	2.53 ± 0.65	
Low	21.94	2.45 ± 0.67	
Missing data	0.12		
Depressive symptomatology (CES-D) (%)⁵			<.0001
No depressive symptom	72.80	2.65 ± 0.58	
Depressive symptom	18.52	2.02 ± 0.67	
Missing data	8.68		
Energy intake (Kcal)	1841.63 ± 480.4	0.037 (0.026, 0.05)	<.0001
BMI (%)			<.0001
Underweight (<18.5 kg/m ²)	4.60	2.41 ± 0.72	
Normal weight (18.5 - 24.9 kg/m ²)	60.39	2.55 ± 0.64	
Overweight (25 - 29.9 kg/m ²)	24.98	2.52 ± 0.63	
Obesity class I (30 - 34.9 kg/m ²)	7.13	2.43 ± 0.68	
Obesity class II (35 - 39.9 kg/m ²)	2.03	2.34 ± 0.72	
Obesity class III (≥40kg/m ²)	0.87	2.24 ± 0.73	
BMI (kg/m²)	24.24 ± 4.52	-0.052 (-0.063, -0.041)	<.0001
Eating Behavior (TFEQ-R21)^{6,7}			
Cognitive restraint	1.72 ± 0.54	-0.10 (-0.12, -0.09)	<.0001
Emotional eating	1.95 ± 0.8	-0.19 (-0.20, -0.18)	<.0001
Uncontrolled eating	2.17 ± 0.61	-0.16 (0.18, -0.15)	<.0001
Eating Disorder (ED) (SCOFF) (%)⁸			<.0001
No	90.24	2.56 ± 0.63	
Yes	9.76	2.21 ± 0.73	
Categories of EDs (SCOFF) (%)^{8,9}			<.0001
No eating disorders	90.24	2.56 ± 0.63	
Restrictive disorders	0.68	2.14 ± 0.80	
Bulimic disorders	2.48	2.24 ± 0.77	
Hyperphagic disorders	5.14	2.20 ± 0.70	
Other type of eating disorders	1.45	2.24 ± 0.73	

CES-D, Center for Epidemiologic Studies Depression scale; BMI, Body Mass Index; EDs, Eating Disorders; LOT-R, Life Orientation Test-Revised; SCOFF, Sick-Control-One-Fat-Food Questionnaire; TFEQ-R21, Revised 21-item Three-Factor Eating Questionnaire

¹ Score ranges from 0 to 4. The highest score corresponds to highest optimism

² All *p* value based on Student test or variance analysis for categorical variables

³ Mean ± SD, all such values

⁴ Pearson correlations (95% CI), all such values

⁵ Score ranges from 0 to 60. The highest score corresponds to highest depressive symptomatology

⁶ *Based on the 26,249 participants who completed the TFEQ-R21 questionnaire*

⁷ *Score ranges from 1 to 4. The highest score corresponds to higher cognitive restraint, emotional eating or uncontrolled eating*

⁸ *Based on the 28,018 participants who completed the SCOFF questionnaire*

⁹ *The Expali algorithm (42) was used to distinguish the different ED categories. It takes into account each SCOFF response and the BMI to classify participants in four broad categories based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Revision (DSM-V) categories of ED.*

Table 2. Association between optimism (LOT-R) and BMI categories in 30,815 participants (NutriNet-Santé study, 2016)

	Model 1 ¹		Model 2 ²		Model 3 ³	
	LOT-R OR (95% CI)	<i>P</i> ⁴	LOT-R OR (95% CI)	<i>P</i> ⁴	LOT-R OR (95% CI)	<i>P</i> ⁴
Underweight (< 18.5 kg/m ²)	0.72 (0.66, 0.78)	<.0001	0.78 (0.72, 0.84)	<.0001	0.82 (0.75, 0.89)	<.0001
Normal (18.5 - 24.9 kg/m ²)	Ref		Ref		Ref	
Overweight (25.0 - 29.9 kg/m ²)	0.92 (0.89, 0.96)	.0002	0.94 (0.90, 0.98)	0.0039	0.97 (0.93, 1.02)	0.24
Obesity class I (30.0 - 34.9 kg/m ²)	0.76 (0.71, 0.81)	<.0001	0.82 (0.77, 0.88)	<.0001	0.88 (0.82, 0.95)	0.0013
Obesity class II (35.0 - 39.9 kg/m ²)	0.63 (0.56, 0.71)	<.0001	0.71 (0.63, 0.80)	<.0001	0.76 (0.67, 0.87)	<.0001
Obesity class III (≥ 40.0 kg/m ²)	0.51 (0.43, 0.61)	<.0001	0.62 (0.52, 0.74)	<.0001	0.69 (0.56, 0.84)	0.0002

LOT-R, Life Orientation Test-Revised

¹ *Model 1: unadjusted.*

² *Model 2: adjusted for age, gender, educational level, occupational status, monthly household income, presence of children in the household, smoking status, physical activity, and dietary energy intake.*

³ *Model 3: model 2 + depressive symptomatology.*

⁴ *P value based on multinomial logistic regression with optimism as a continuous independent variable.*

Table 3. Association between optimism (LOT-R) and eating behavior (TFEQ-R21) in 26,249 participants (NutriNet-Santé study, 2016)

	Model 1 ¹		Model 2 ²		Model 3 ³	
	LOT-R		LOT-R		LOT-R	
	Beta-coefficients	<i>P</i> ⁴	Beta-coefficients	<i>P</i> ⁴	Beta-coefficients	<i>P</i> ⁴
	(95% CI)		(95% CI)		(95% CI)	
Cognitive restraint	-0.10 (-0.11, -0.09)	<0.0001	-0.10 (-0.11, -0.09)	<0.0001	-0.07 (-0.08, -0.06)	<0.0001
Emotional eating	-0.24 (-0.25, -0.22)	<0.0001	-0.23 (-0.24, -0.21)	<0.0001	-0.17 (-0.19, -0.16)	<0.0001
Uncontrolled eating	-0.13 (-0.14, -0.12)	<0.0001	-0.13 (-0.14, -0.12)	<0.0001	-0.10 (-0.11, -0.09)	<0.0001

LOT-R, Life Orientation Test-Revised; TFEQ-R21, Revised 21-item Three-Factor Eating Questionnaire

¹ *Model 1: unadjusted.*

² *Model 2: adjusted for age, gender, educational level, occupational status, monthly household income, presence of children in the household, smoking status, physical activity, and dietary energy intake.*

³ *Model 3: model 2 + depressive symptomatology.*

⁴ *P value based on linear regression, with optimism as a continuous independent variable.*

Table 4. Association between optimism (LOT-R) and the risk of eating disorders (EDs) (SCOFF) in 28,018 participants (NutriNet-Santé study, 2016)

	Model 1 ¹		Model 2 ²		Model 3 ³	
	LOT-R	<i>P</i> ⁴	LOT-R	<i>P</i> ⁴	LOT-R	<i>P</i> ⁴
	OR (95% CI)		OR (95% CI)		OR (95% CI)	
Eating disorders (SCOFF)						
No	Ref		Ref		Ref	
Yes	0.46 (0.44, 0.49)	<.0001	0.50 (0.47, 0.53)	<.0001	0.60 (0.56, 0.64)	<.0001
Category of Eating disorders (SCOFF)⁵						
No eating disorders	Ref		Ref		Ref	
Restrictive disorders	0.40 (0.33, 0.49)	<.0001	0.45 (0.37, 0.55)	<.0001	0.55 (0.44, 0.68)	<.0001
Bulimic disorders	0.49 (0.44, 0.55)	<.0001	0.53 (0.48, 0.59)	<.0001	0.65 (0.58, 0.73)	<.0001
Hyperphagic disorders	0.45 (0.42, 0.49)	<.0001	0.49 (0.45, 0.53)	<.0001	0.61 (0.56, 0.66)	<.0001
Other eating disorders	0.49 (0.43, 0.56)	<.0001	0.52 (0.45, 0.60)	<.0001	0.60 (0.51, 0.70)	<.0001

LOT-R, Life Orientation Test-Revised; SCOFF, Sick-Control-One-Fat-Food Questionnaire

¹ Model 1: unadjusted.

² Model 2: adjusted for age, gender, educational level, occupational status, monthly household income, presence of children in the household, smoking status, physical activity, and dietary energy intake.

³ Model 3: model 2 + depressive symptomatology.

⁴ *P* value based on binary (yes vs no) or multinomial (categories of EDs) logistic regression with optimism as a continuous independent variable.

⁵*The Expali algorithm (42) was used to distinguish the different ED categories. It takes into account each SCOFF response and the BMI to classify participants in four broad categories based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Revision (DSM-V) categories of ED.*