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Is organic food consumption associated with life satisfaction? A cross-sectional analysis from the NutriNet-Santé study

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ABSTRACT

Well-being is often mentioned as an important motive for organic food consumption. Little is known about the relationship between organic food consumption and life satisfaction (a component of well-being). The aim of this study was to investigate the cross-sectional relationship between organic food consumption and life satisfaction.

A total of 17,446 volunteers aged 45 or above, from the NutriNet-Santé cohort filled in an organic food semi-quantitative frequency questionnaire and completed the French validated satisfaction with life scale (range score 5–35). Adjusted means (95% confidence intervals) of the satisfaction with life score across quintiles of contribution of organic food to the diet (total and by food group) were estimated using ANCOVA models.

In multivariable model, life satisfaction among lowest and highest consumers of organic food reached 24.98 (95%CI: 24.78–25.17) and 25.52 (95%CI: 25.33–25.71) respectively (P trend < 0.0001). Life satisfaction was slightly and positively associated with higher contribution of organic food to the diet (overall and in most food groups).

Our findings suggest that high organic food consumption may play a role in life satisfaction of participants over 45 years old through hedonist or eudemonic approaches.

1. Introduction

There is a body of evidence suggesting that subjective well-being has positive effects on health (Feller et al., 2013; Koivumaa-Honkanen et al., 2001; Kim et al., 2014; Dolan et al., 2008), arguing the need to conduct extensive research to better understand what contributes to our psychological well-being. Edward Diener et al. have defined three core components of the subjective well-being: positive affect, negative affect, and a cognitive component, referring to the life satisfaction (Diener et al., 1985). The first and second components assess the emotional aspects of well-being (i.e. pleasant and unpleasant mood) and are more fluctuating compared to the latter component which is defined as "*a global assessment of a person's quality of life according to his/her chosen criteria*" (Diener et al., 1985). The concept of life satisfaction integrates the gap between the ideal life of each and reality.

Many factors affecting life satisfaction have been identified such as physical activity, raising children, be married or income level (Dolan et al., 2008; Diener et al., 2013). With regard to dietary factors, some studies reported that a healthy diet may be related to a higher life satisfaction (Alberto Grao-Cruces, 2013; Blanchflower et al., 2013). For instance, a Spanish study among 1973 teenagers found that individuals who were the most satisfied with their life (assessed using the satisfaction with life scale (SWLS)) exhibited dietary patterns following better the Mediterranean diet (Alberto Grao-Cruces, 2013). However, a recent study carried out among older Finnish women did not observe any associations between life satisfaction and adherence to a healthy diet (assessed by the Basic Sea Diet) (Ruiz de Santiago y Nevarez, 2016).

In Australia, regular organic consumers globally scored higher on the Australian Unity Personal Well-being Index (PWI-A) than the general population (Oates and Oates, 2013). A recent study showed also an influence of organic food consumption on subjective well-being

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(Apaolaza et al., 2018). However, European epidemiological researches investigating the links between organic based-diet and well-being are seldom, while French individuals frequently associate organic food consumption with well-being. Indeed, a cross-cultural study showed that when participants were asked to write down the first words coming to their mind when thinking about food and well-being, the word "organic" was the fourth to be cited by a sample of 150 French participants (Ares et al., 2015). Individuals choose organic foods mainly because they consider them healthier, tastier and environmentally friendly (Hughner et al., 2007; Aertsens et al., 2011; Padilla Bravo et al., 2013; Baudry et al., 2017a; Pino et al., 2012; de Magistris and Gracia, 2008), that is to say, a combination of hedonist motives (feeling pleasure) and eudemonic motives (pursuing the right ends), which could both affect subjective life satisfaction (Venhoeven et al., 2013). In addition, an experiment showed that the influence of organic food consumption on subjective well-being can be the consequence of a label effect (Apaolaza et al., 2018). However, label effect may also depend on the share of processing in the diet (Prada et al., 2017). In addition, according to AgenceBio, organic French consumers prefer the organic food groups, known to be healthier than processed foods (http://www.agence-bio.org/comprendre-le-consommateur-bio, n.d.). Moreover, many studies have shown that organic food consumption patterns were positively linked with a healthy diet (Baudry et al., 2016; Kesse-Guyot et al., 2013; Eisinger-Watzl et al., 2015; Torjusen et al., 2012; Torjusen et al., 2010; Rembiałkowska et al., 2008). Therefore, overall healthy dietary pattern of organic food consumers combined with organic label effect may concomitantly affect their satisfaction with life.

Assuming that life satisfaction has a beneficial effects on health (Feller et al., 2013; Koivumaa-Honkanen et al., 2001; Kim et al., 2014; Dolan et al., 2008), it seems relevant to better understand how life satisfaction may be affected by consumption of organic food, which is beneficial for the environment independently of dietary patterns (Strassner et al., 2015; Reganold and Wachter, 2016) and may protect against diseases (Kummeling et al., 2008; Bradbury et al., 2014; Huber et al., 2011).

Therefore, the objective of this cross-sectional study was to explore the association between the contribution of organic food consumption to the diet and life satisfaction using a validated scale (SWLS), in a large sample of participants from the NutriNet-Santé study.

2. Methods

2.1. Population

Participants were part of a large web-based prospective observational French cohort (NutriNet-Santé) of volunteers aged 18 years or older, launched in May 2009 with a scheduled follow-up of 10 years. The design and details of the study has been described elsewhere (Hercberg et al., 2010). The design was conducted according to the guidelines laid down in the Declaration of Helsinki and was approved by the Institutional Review Board of the French Institute for Health and Medical Research (IRB Inserm no. 0000388FWA00005831) and the "Commission Nationale de l'Informatique et des Libertés" (CNIL no. 908450 and no. 909216). All participants signed an electronic informed consent.

2.2. Data collection and treatment

2.2.1. Socio-demographic, lifestyle and health characteristics

At baseline and yearly thereafter, participants were invited to fill in self-administered web-questionnaires inquiring sociodemographic, anthropometric, health and lifestyle characteristics (Vergnaud et al., 2011; Lassale et al., 2013; Touvier et al., 2010). Data collected included date of birth, gender, graduation (< high school diploma, high school diploma and post-secondary graduate), income, household size, smoking status (former, current and never-smoker), number of children, marital status (single, widowed/divorced/separated and cohabiting), occupational categories (farmer, craftsman/shopkeeper/business owner, managerial staff, intermediate profession, employee, manual worker, student and never employed), location (rural community, urban unit < 20,000 inhabitants, urban unit between 20,000 and 200,000 inhabitants, and urban unit > 200,000 inhabitants), weight and height. Body mass index (BMI) (kg/m^2) was calculated. Health events such as cancers and cardiovascular diseases were declared, leading to the collection of medical records (diagnosis, hospitalization, etc.) by the medical team. Data were then reviewed by a physician expert committee for validation. To estimate the presence of depressive symptoms, participants had to fill in the French validated Center for Epidemiologic Studies Depression scale (CES-D) (Morin et al., 2011), ranging from 0 to 60 (60 corresponding to the greatest number of depressive symptoms (Shafer, 2006)). Men and women with CES-D score strictly above 17 and 23 respectively were considered to present depressive symptoms (Husaini and Neff, 1980). Physical activity was assessed using the self-administered French short form of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003; Hallal and Victora, 2004; Hagströmer et al., 2006). Data were converted into equivalent hours of walking and three categories were defined (no regular physical activity, equivalent to < 1 h of walking/d, equivalent to > 1 h of walking/d and missing category). Monthly income per household unit was computed by dividing income by the number of consumption units (CU): 1 CU for the first adult in the household, 0.5 CU for other persons older than 14 years old and 0.3 CU for others (Insee, 2015). Participants were categorized into five classes: refuse to declare, < 1200€/m, 1200–1800€/m, 1800–2700€/m, > 2700€/m. For each participant, the closest available data to the dietary data collection period were used for the analysis.

2.2.2. Dietary data

In October 2014, participants of NutriNet-Santé study were invited to fill in an optional complementary organic food semi-quantitative frequency questionnaire (Org-FFQ) (Baudry et al., 2015), based on a previously validated FFQ (Kesse-Guyot et al., 2010). The Org-FFQ allowed us to estimate consumption of 264 food items, by multiplying the consumption frequencies (yearly, monthly, weekly or daily units) over the past year and the usual portion size consumed (described as typical household measurements or with colour photographs) for each participant. In addition, participants were asked to answer the following question: "How often was the product of organic origin?" for almost each item, except 6 for which there is no organic equivalent. To estimate the organic intake for each food item, a weight of 0, 0.25, 0.5, 0.75 and 1 was respectively applied to the answering modalities: never, rarely, half the time, often and always. Then, the score was obtained by dividing the total organic food intake (in g/d) by the total food intake (g/d), multiplied by 100.

This variable was used as an overall indicator of the contribution of organic food in the whole diet. The same procedure was used for the calculation of contribution of organic food to food groups (i.e. by dividing total organic food group intake by the total food group intake). Nutrient intakes were estimated using the published NutriNet-Santé food composition database (Nutrinet-Santé, 2013).

The a priori dietary score mPNNS-GS (modified Programme National Nutrition Santé-Guidelines score) on 13.5 point was computed, to account for the level of adherence to French nutritional guidelines (Estaquio et al., 2009). The mPNNS-GS is composed of twelve components, eight of which referred to food-serving recommendations, and four to moderation in consumption. The details of the mPNNS-GS scoring have been described elsewhere (Estaquio et al., 2009).

The energy requirement of each participant, accounting for physical activity level and basal metabolic rate, was estimated by Schofield's equations (Wn, 1984) according to sex, BMI and age. Individuals with a ratio of energy intake divided by energy requirement below 0.35 or

above 1.93 were considered as under-reporting or over-reporting, and were excluded from the analysis.

We categorized the participants in three groups according to their alcohol consumption declared in the org-FFQ (abstinent, moderate drinker (< 20 g/d for women and < 30 g/d for men), and high alcohol drinker (≥ 20 g/d for women and ≥ 30 g/d for men) (Manger Bouger, n.d.).

2.2.3. Assessment of life satisfaction

In October 2015, participants who were at least 45 years old were invited to complete an optional questionnaire to assess the healthy aging with a specific section devoted to the SWLS (Diener et al., 1985). The scale, developed by Diener et al. (Diener et al., 1985), consisted of five statements: 1) in most ways my life is close to my ideal, 2) the conditions of my life are excellent, 3) I am satisfied with my life, 4) so far I have gotten the important things I want in life, and 5) if I could live my life over, I would change almost nothing. For each statement, participants had to indicate their degree of agreement, using a 7-point Likert scale from strongly agree to strongly disagree. The total score varies from 5 to 35 (with 35 corresponding to the highest life satisfaction score). In this study, a French validated version was used (Blais et al., 1989). The Cronbach alpha coefficient of the scale in our sample was 0.90, showing a good internal consistency.

2.3. Statistical analyses

In October 2014 a total of 33,384 participants had completed the Org-FFQ, and a total of 28,174 participants had validated data with no missing value for sociodemographic characteristics and were not under or over-reporters. Measurement of life satisfaction was available for a subsample of 17,446 participants.

Baseline characteristics are presented across quintiles of contribution of organic food to the whole diet. Means and standard deviations or percentages are presented. P-values were calculated using linear contrast tests (for continuous variables) or Mantel-Haenszel chi-square tests (for categorical variables). Means and confidence intervals (95%CI) of SWLS were estimated across quintiles of contribution of organic food to the diet using ANCOVA models. After adjustment for multiple testing using the Dunnett's correction, P for linear trend across quintiles are reported. Adjusted means and confidence intervals were computed according to the observed margins.

The first model was unadjusted. As several factors were both related to life satisfaction and organic food consumption, we ran a second model adjusted for: age, sex, alcohol consumption, income, graduation, smoking status, physical activity, marital status, socio-professional category, presence of children and adherence with French nutritional guidelines (mPNNS-GS). In addition, our second models were adjusted for alcohol-free energy intake, BMI, history of cancer and history of cardiovascular diseases which have been associated with organic food consumption.

A supplementary model was further adjusted for the presence of depressive symptoms which were strongly correlated with life satisfaction (in our sample, Spearman correlation = − 0.58).

Similar analyses were conducted to estimate the association between the contribution of organic food to each food group (vegetables and fruits, starchy foods, meat, fish, eggs, dairy products, sweet food, snack and fast-food) and SWLS. In these models, adjustments were made on the overall consumption of the specific food group.

All analyses were performed using SAS 9.4 software. For statistical tests, the type I error was set at 5%.

3. Results

Table 1 presents the main characteristics of participants across quintiles of contribution of organic food to the whole diet. Participants in the first quintile, consumed no or less than 3% of organic food, while in the last quintile participants consumed more than 50% of organic food (in weight, % g/d). Of note, the last quintile has the largest range, gathering in the same group participants with exclusive organic food consumption and participants with high organic food consumption but not exclusive leading to a heterogeneous group. Table 1 shows that unless history of cancer, all sociodemographic or lifestyle factors were significantly associated with organic food consumption. Participants with the highest organic food consumption (quintile 5) were more likely to be women, single, slightly younger, more physically active, non-smokers and moderate drinkers. They were less likely to have biological or adopted children. Participants with the highest organic food consumption had generally higher mPNNS-GS, reflecting a higher level of adherence to French food-based recommendations defined by the PNNS (Programme National Nutrition Santé) compared to other groups. They also reported less often a history of cardiovascular diseases were less often suffering from depressive symptoms. Compared to other groups, their BMI was lower.

Overall, the average of SWLS was 25.12/35 (5.93) in the analyzed population. Table 2 presents the associations between quintiles of contribution of organic food to the diet and the SWLS for the total sample. In the unadjusted model, participants with higher organic food consumption presented higher life satisfaction. The mean difference between the first and the fifth quintiles was 0.94. The differences between the first and fourth and the second and fifth quintiles were also statistically-significant but to a lesser extent.

In the second model (main model), differences between the first and fifth quintiles only were statistically significant. In the supplementary model, additional adjustment for depressive symptoms led to attenuation, (the difference between the first and the fifth quintiles was 0.42) but remained significant.

Table 3 shows the associations between quintiles of contribution of organic food group for each food group and life satisfaction. Significant associations were observed (except for the snack food group in the adjusted model), showing that life satisfaction is in average higher among participants with higher organic consumption in most of the food groups. Furthermore, the associations were more or less strong depending on food groups. For vegetables and fruits, meat, fish, dairy products and fast-food the differences between the first and the fifth quintiles were comparable to the differences observed for the overall contribution, while for starch, egg, sweet food and snack the associations were attenuated.

4. Discussion

The present study showed that volunteers with diets rich in organic food (fourth and fifth quintiles) were slightly more satisfied with their life than others. Moreover, participant with an organic food pattern presented specific sociodemographic and lifestyle characteristic, as already shown in other studies (Baudry et al., 2016; Eisinger-Watzl et al., 2015; Baudry et al., 2017b). In addition, many studies have shown that the diet composition of organic food consumers was often healthier (Torjusen et al., 2012; Torjusen et al., 2010; Huber et al., 2011; Baudry et al., 2017b). However, even after adjustments for cofounding variables, the relationship between organic food consumption and life satisfaction remained slightly attenuated.

Similar results were observed for most food groups except for the snack food group for which no association was found in the adjusted model. However, the range of the differences varied across food groups. Differences were attenuated when we tested with unhealthy or processed food.

Several hypotheses may be advanced to explain the association between organic food consumption and life satisfaction and more generally with well-being.

First of all, choosing organic food could be driven by altruist or ethical motives (Baudry et al., 2017a; Honkanen et al., 2006), although such assertion may also threat the well-being as other pro-

Table 1
Characteristics of the participants across quintiles of contribution of organic food to the diet, NutriNet-Santé study, 2014, N = 17,446.

	All	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	P-value[a]
N	17,466	3407	3466	3521	3542	3510	
Limits of quintile (in % of weight)	[0 – 100]	[0–2.9]	[2.9–15.3]	[15.3–30.3]	[30.3–54.3]	[54.3–100]	
Contribution (in % of weight) of organic food to the diet	29.7 (27.1)	0.6 (0.8)	8.7 (3.65)	22.7 (4.26)	41.3 (6.88)	74.0 (13.31)	
Male (%)	30.28	40.83	31.42	29.68	26.71	23.11	< 0.0001
Age (years)	60.5 (8.6)	61.4 (9.2)	60.3 (8.7)	60.6 (8.5)	60.3 (8.1)	59.9 (8.4)	< 0.0001
Marital status (%)							0.02
Single	8.26	7.92	8.48	7.81	7.85	9.23	
Widowed or divorced or separated	16.37	16.03	15.52	17.04	15.05	18.21	
Cohabiting	75.37	76.05	76.00	75.15	77.10	72.56	
Children[c] (%)	86.09	86.35	86.32	87.56	85.49	84.76	0.03
Graduation (%)							< 0.0001
< High school diploma	27.55	34.28	27.47	27.95	26.40	21.85	
High school diploma	16.44	16.97	16.50	16.42	16.18	16.15	
Post-secondary graduate	56.01	48.75	56.03	55.64	57.43	61.99	
Monthly income per household unit (%)							0.0003
Refuse to declare	12.51	13.06	12.64	12.50	12.45	11.94	
< 1200€	8.52	10.95	8.22	7.58	7.40	8.52	
1200–1800€	20.16	21.25	19.91	19.65	18.82	20.20	
1800–2700€	25.20	23.72	25.33	25.53	25.18	26.21	
> 2700€	33.61	31.02	33.90	34.73	35.15	33.13	
Physical activity level (%)							< 0.0001
Missing value[b]	10.62	12.00	10.44	10.85	10.56	9.29	
No regular physical activity	17.25	20.81	19.47	17.07	15.58	13.48	
Equivalent to < 1 h of walking/d	35.46	32.96	37.28	35.33	36.11	35.56	
Equivalent to > 1 h of walking/d	36.67	34.22	32.80	36.75	37.75	41.68	
Smoking status (%)							< 0.0001
Former smoker	46.27	47.81	46.60	46.69	45.48	44.81	
Current smoker	9.03	9.98	10.39	9.20	8.07	7.58	
Non-smoker	44.70	42.21	43.02	44.11	46.44	47.61	
Alcohol consumption (%)							< 0.0001
Abstainer	4.75	5.64	3.92	4.15	3.81	6.24	
Moderate drinker(< 20 g/d for women and 30 g/d for men)	84.21	80.42	83.93	84.18	86.11	86.27	
High drinker (≥ 20 g/d for women and 30 g/d for men)	11.05	13.94	12.15	11.67	10.08	7.49	
Total free-alcohol energy intake (kcal/d))	1960 (610)	1942 (627)	1956 (603)	1948 (590)	1972 (620)	1982 (608)	0.003
mPNNS-GS (/13.5)	8.67 (1.75)	8.32 (1.73)	8.51 (1.74)	8.7 (1.69)	8.81 (1.78)	8.99 (1.73)	< 0.0001
BMI (kg/m^2)	24.60 (4.44)	25.55 (4.72)	24.92 (4.47)	24.72 (4.43)	24.39 (4.22)	23.44 (4.08)	< 0.0001
History of cancer (%)	11.30	11.24	10.91	11.67	11.60	11.05	0.85
History of cardiovascular disease (%)	4.40	6.22	4.41	4.71	3.70	2.99	< 0.0001
Presence of depressive symptom[d] (%)	8.92	10.60	9.81	8.83	8.47	6.98	< 0.0001

Values are % or means (SD) as appropriate.
[a] Mantel-Haenszel Chi^2 trend test or linear test using contrast from ANCOVA.
[b] Optional questionnaire.
[c] Biological or adopted.
[d] Using the CES-D with cut-offs of 17/60 in men and 23/60 in women respectively.

Table 2
Association between quintiles of contribution of organic food to the diet and life satisfaction scale, NutriNet-Santé study, 2014, N = 17,446.

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	P[a]
	N = 3407	N = 3466	N = 3521	N = 3542	N = 3510	
Model 1[b]	24.71 (24.51–24.91)	24.88 (24.68–25.07)	25.02 (24.83–25.22)	25.34 (25.14–25.53)	25.65 (25.46–25.85)	< 0.0001
Model 2[c]	24.98 (24.78–25.17)	24.93 (24.74–25.12)	24.99 (24.8–25.17)	25.2 (25.01–25.38)	25.52 (25.33–25.71)	< 0.0001
Model 3[d]	25.01 (24.83–25.18)	24.98 (24.81–25.15)	24.99 (24.82–25.15)	25.21 (25.04–25.38)	25.43 (25.26–25.60)	0.0002

Values are adjusted means (95%CI) computed according to observe margins.
[a] P for trend using linear contrast.
[b] Model 1 is crude.
[c] Model 2 is adjusted for sex, age, alcohol consumption, income, graduation, smoking status, physical activity, history of cancer, history of cardiovascular disease, marital status, socio-professional category, BMI, parenthood, mPNNS-GS, and alcohol-free energy intake.
[d] Model 3 is model 2 further adjusted for current depressive symptoms.

environmental behaviors (Venhoeven et al., 2013). Indeed, organic food consumers accept to buy organic foods, which are generally more expensive and less available (seasonality for example) (Organic Agriculture, n.d.), however consuming organic food allows them to stay consistent with their beliefs (Venhoeven et al., 2013). In other words, organic food consumption could reflect a militant act to contest against the current agro food system that damages the environment and causes the depletion of earth natural resources and animal welfare (Baudry et al., 2017a). In particular, by fostering the organic food market, some consumers may support an alternative agricultural system that they consider better for the planet as well as for animal welfare. In that sense, organic food consumption can be seen in an eudemonic approach of well-being, and consequently may participate in improving life satisfaction (Venhoeven et al., 2013).

Table 3
Association between quintiles of contribution of organic food groups to the diet and life satisfaction scale, NutriNet-Santé study, 2014, N = 17,446.

Food groups	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	P[a]
Vegetables and fruits	N = 3465	N = 3472	N = 3470	N = 3518	N = 3521	
Model 1[b]	24.78 (24.58–24.98)	24.8 (24.60–25.00)	25.06 (24.87–25.26)	25.25 (25.05–25.44)	25.71 (25.52–25.91)	< 0.0001
Model 2[c]	25.05 (24.86–25.24)	24.85 (24.66–25.04)	25.04 (24.85–25.23)	25.08 (24.89–25.27)	25.59 (25.4–25.78)	0.0002
Starches	N = 3754	N = 3061	N = 3566	N = 3520	N = 3545	
Model 1[b]	24.81 (24.62–25.00)	25.11 (24.9–25.32)	24.94 (24.74–25.13)	25.31 (25.11–25.50)	25.47 (25.27–25.66)	< 0.0001
Model 2[c]	25.08 (24.90–25.27)	25.07 (24.87–25.27)	24.93 (24.75–25.11)	25.18 (24.99–25.37)	25.35 (25.16–25.53)	0.0173
Meat	N = 4750	N = 1710	N = 3360	N = 3665	N = 3961	
Model 1[b]	24.65 (24.48–24.81)	24.87 (24.59–25.16)	25.00 (24.80–25.20)	25.38 (25.19–25.58)	25.67 (25.48–25.85)	< 0.0001
Model 2[c]	24.95 (24.79–25.12)	24.94 (24.67–25.21)	24.94 (24.75–25.13)	25.20 (25.02–25.38)	25.49 (25.31–25.66)	< 0.0001
Fish		N = 8645	N = 1509	N = 3551	N = 3741	
Model 1[b]		24.82 (24.69–24.94)	25.31 (25.01–25.60)	25.28 (25.09–25.48)	25.61 (25.42–25.80)	< 0.0001
Model 2[c]		24.97 (24.85–25.09)	25.11 (24.83–25.39)	25.16 (24.98–25.35)	25.44 (25.26–25.62)	0.0003
Eggs	N = 4448	N = 2666	N = 1944	N = 3125	N = 5263	< 0.0001
Model 1[b]	24.76 (24.59–24.93)	25.13 (24.91–25.36)	24.94 (24.68–25.20)	25.29 (25.08–25.50)	25.40 (25.24–25.56)	0.0002
Model 2[c]	24.95 (24.79–25.12)	25.06 (24.85–25.28)	24.91 (24.66–25.16)	25.16 (24.96–25.36)	25.35 (25.20–25.51)	
Dairy products	N = 5289	N = 1383	N = 3478	N = 3662	N = 3634	
Model 1[b]	24.77 (24.61–24.93)	24.95 (24.63–25.26)	25.01 (24.82–25.21)	25.30 (25.11–25.49)	25.63 (25.44–25.83)	< 0.0001
Model 2[c]	25.03 (24.87–25.18)	24.96 (24.66–25.26)	24.93 (24.74–25.12)	25.2 (25.02–25.38)	25.43 (25.24–25.61)	0.004
Sweet food[d]	N = 3421	N = 3608	N = 3393	N = 3515	N = 3509	
Model 1[b]	24.78 (24.58–24.97)	25.04 (24.84–25.23)	25.11 (24.92–25.31)	25.17 (24.97–25.36)	25.52 (25.32–25.71)	< 0.0001
Model 2[c]	25.09 (24.89–25.28)	25.06 (24.88–25.24)	25.01 (24.82–25.20)	25.07 (24.89–25.26)	25.39 (25.2–25.57)	0.022
Snack[e]		N = 9682	N = 649	N = 3608	N = 3507	
Model 1[b]		24.92 (24.80–25.04)	25.39 (24.93–25.84)	25.3 (25.10–25.49)	25.45 (25.26–25.65)	0.0046
Model 2[c]		25.06 (24.95–25.17)	25.15 (24.71–25.58)	25.13 (24.95–25.32)	25.28 (25.09–25.47)	0.1642
Fast food[f]		N = 8501	N = 1868	N = 3558	N = 3519	
Model 1[b]		24.86 (24.74–24.99)	25.19 (24.92–25.45)	25.18 (24.99–25.38)	25.66 (25.46–25.85)	< 0.0001
Model 2[c]		25.01 (24.89–25.13)	25.02 (24.76–25.27)	25.07 (24.89–25.26)	25.5 (25.31–25.69)	0.0002

Values are adjusted means (95%CI) computed according to observe margins.
[a] P for trend using linear contrast.
[b] Model 1 is unadjusted.
[c] Model 2: Adjustment for sex, age, alcohol consumption, income, graduation, smoking status, physical activity, history of cancer, history of cardiovascular disease, marital status, socio professional category, BMI, having children, mPNNS-GS, and energy intake without alcohol.
[d] Sweet foods include: dairy desserts, cookies, jam, honey, candy, breakfast cereals, ice cream, cake, chocolate and soda.
[e] Snack: chips, salty biscuits, popcorn, and oil salted seeds.
[f] Fast food: sandwich, hamburger, pizza, crepe, choucroute and cassoulet.

Secondly, dietary patterns and other characteristics of organic food consumers may explain the association observed. Indeed, in this cohort or others, organic food consumers exhibit healthy dietary patterns including high plant-based food consumption and low consumption of animal products as well as healthy lifestyles (Baudry et al., 2016; Kesse-Guyot et al., 2013; Eisinger-Watzl et al., 2015; Torjusen et al., 2012; Torjusen et al., 2010; Rembiałkowska et al., 2008). Existing studies have generally reported that participants with a balanced and heathy diet were more satisfied with their life (Alberto Grao-Cruces, 2013; Blanchflower et al., 2013; Schnettler et al., 2015) although a Finish study did not detect any association between life satisfaction and adherence to a healthy diet (reflected by a Basic Sea Diet) (Ruiz de Santiago y Nevarez, 2016). Another study conducted in a population of young adults (18–30 years) reported a positive relationship between life satisfaction and healthy behaviors such as tobacco abstinence, physical exercise, sun protection, fruit intake, and fitness (Grant et al., 2009). The authors assumed that individuals exhibiting a low satisfaction with their lives may exert less self-care, such as engagement in a healthy diet (Grant et al., 2009). We may also hypothesize that people who are unsatisfied with their life may be faced with more central concerns than organic consumption considerations. Indeed, a study showed that organic food consumers perceive a higher degree of emotional well-being when they eat organic food than non-organic eaters (Apaolaza et al., 2018). However, no argument allows us to document the causal link between organic food consumption and life satisfaction.

In our study, we observed a slight association between overall organic food consumption and life satisfaction but also across food groups (after controlling for food group intake and overall nutritional quality of the diet). Noteworthy, these associations were also detected for food groups usually considered unhealthy such as meat or sweet products suggesting that the overall healthy diet of organic consumers is not the only underlying factor explaining the link with life satisfaction.

Thirdly, as organic consumers are generally motivated by the healthy facet of the diet (Baudry et al., 2017a; Pino et al., 2012; de Magistris and Gracia, 2008), we can postulate that they are more satisfied with their food that they consider for instance without GMO (genetically modified organism) or chemical pesticide free. A study conducted in a German population investigated motives of organic consumers and consumers of functional foods (i.e. enriched with substances such as probiotics, prebiotics, macronutrients or micronutrients). This study reported that both types of consumers were affected by healthy motives. However, organic food consumers were influenced by a holistic healthy lifestyle including a healthy diet and sport while functional food consumption consumers were characterized by only small modification in their diet to improve health and well-being (Goetzke et al., 2014).

Some limitation of the study should be mentioned. First, the observational cross-sectional design did not allow us to infer causality between organic food preference and life satisfaction. Secondly, our results showed only slight differences, however, this difference remained significant, after adjustment on multiple cofounding factors. Moreover, according to the classification of Diener and Pavot (Pavot and Diener, 1993), the population is globally satisfied with their life (general mean is above 25/35), that can explain why only small differences were seen. Thirdly, participants were volunteers involved in a long-term cohort focusing on nutrition, so they exhibit particular characteristics including sensitivity to nutritional issues and high level of qualification (Andreeva et al., 2015; Andreeva et al., 2016). Thus caution is needed when extrapolating the results to the overall

population in particular because the present sample is 45 years of age or older.

The last quintile presents a larger range of organic food consumption, however the differences between the exclusive organic food consumers and the others participants in the fifth quintile were not evaluated. Yet, although the statistical models included many confounders, some other unmeasured factors may have been omitted leading to residual confounding. We did not study all the components of well-being but only the cognitive components, while organic food consumption should also affect the other components. Finally, organic food consumption was assessed using a FFQ, prone to measurement error, as most of self-administered methods of food consumption assessment (Cade et al., 2002). The use of a FFQ and particular socioeconomic and behavioral characteristics of participants may explain the high organic food consumption in our sample.

However, our study also presented important strengths. Indeed, the use of a semi-quantitative FFQ that included 264 items with 5 modalities as regards organic/conventional consumption allowed assessing the organic consumption in detail (overall and by food group). We also used a validated scale with 5 questions to evaluate life satisfaction. Finally, the high number of participants enabled a large variation in individual behaviors.

5. Conclusions

In conclusion, this study provides new insights concerning the potential link between organic food consumption and life satisfaction. Higher contribution of organic food to the diet may help to improve life satisfaction of people aged 45 and more through hedonist or eudemonic approaches but longitudinal studies are needed to better characterize the direction of causation.

Abbreviations

ANCOVA analysis of covariance
BMI body mass index
GMO genetically modified organism
mPNNS-GS modified Programme National Nutrition Santé Guideline-score
Org-FFQ organic food frequency questionnaire
PNNS Programme National Nutrition Santé
SWLS satisfaction with life scale

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Conflict of interest

None of the authors declared any conflict of interest.

References

Comprendre le consommateur bio - Agence Française pour le Développement et la Promotion de l'Agriculture Biologique - Agence BIO. Available from: http://www.agencebio.org/comprendre-le-consommateur-bio (Internet, cited 2017 Sep 1).
Manger Bouger Available from: http://www.mangerbouger.fr/ (Internet, cited 2016 Nov 10).
Aertsens, J., Mondelaers, K., Verbeke, W., Buysse, J., Van Huylenbroeck, G., 2011. The influence of subjective and objective knowledge on attitude, motivations and consumption of organic food. Br. Food J. 113 (11), 1353–1378 (Oct 25).
Alberto Grao-Cruces, A.N., 2013. Adherencia a La Dieta Mediterránea En Adolescentes Rurales Y Urbanos. Nutr. Hosp. 1 (4), 1129–1135 (Jul).
Andreeva, V.A., Salanave, B., Castetbon, K., et al., 2015. Comparison of the sociodemographic characteristics of the large NutriNet-Santé e-cohort with French Census data: the issue of volunteer bias revisited. J. Epidemiol. Community Health 69, 893–898 (Apr 1; jech-2014-205263).
Andreeva, V.A., Deschamps, V., Salanave, B., et al., 2016. Comparison of dietary intakes between a large online cohort study (Etude NutriNet-Santé) and a nationally representative cross-sectional study (Etude Nationale Nutrition Santé) in France: addressing the issue of generalizability in E-epidemiology. Am. J. Epidemiol. 184 (9), 660–669 (Nov 1).
Apaolaza, V., Hartmann, P., D'Souza, C., López, C.M., 2018. Eat organic – feel good? The relationship between organic food consumption, health concern and subjective wellbeing. Food Qual. Prefer. 63, 51–62 (Jan 1).
Ares, G., de Saldamando, L., Giménez, A., et al., 2015. Consumers' associations with wellbeing in a food-related context: a cross-cultural study. Food Qual. Prefer. 40 (Part B), 304–315 (Mar).
Baudry, J., Méjean, C., Allès, B., et al., 2015. Contribution of organic food to the diet in a large sample of French adults (the NutriNet-Santé Cohort Study). Nutrients 7 (10), 8615–8632 (Oct 21).
Baudry, J., Touvier, M., Allès, B., et al., 2016. Typology of eaters based on conventional and organic food consumption: results from the NutriNet-Santé cohort study. Br. J. Nutr. 116 (04), 700–709 (Aug).
Baudry, J., Péneau, S., Allès, B., et al., 2017a. Food choice motives when purchasing in organic and conventional consumer clusters: focus on sustainable concerns (The NutriNet-Santé Cohort Study). Nutrients 9 (2), 88 (Jan 24).
Baudry, J., Allès, B., Péneau, S., et al., 2017b. Dietary intakes and diet quality according to levels of organic food consumption by French adults: cross-sectional findings from the NutriNet-Santé Cohort Study. Public Health Nutr. 20 (04), 638–648 (Mar).
Blais, M.R., Vallerand, R.J., Pelletier, L.G., Brière, N.M., 1989. L'échelle de satisfaction de vie: Validation canadienne-française du 'Satisfaction with Life Scale'. Can. J. Behav. Sci. Rev. Can. Sci. Comport. 21 (2), 210–223.
Blanchflower, D.G., Oswald, A.J., Stewart-Brown, S. Is, 2013. Psychological well-being linked to the consumption of fruit and vegetables? Soc. Indic. Res. 114 (3), 785–801 (Dec).
Bradbury, K.E., Balkwill, A., Spencer, E.A., et al., 2014. Organic food consumption and the incidence of cancer in a large prospective study of women in the United Kingdom. Br. J. Cancer 110 (9), 2321–2326 (Apr 29).
Cade, J., Thompson, R., Burley, V., Warm, D., 2002. Development, validation and utilisation of food-frequency questionnaires - a review. Public Health Nutr. 5 (4), 567–587 (Aug).
Craig, C.L., Marshall, A.L., Sjostrom, M., et al., 2003. International physical activity questionnaire: 12-country reliability and validity. Med. Sci. Sports Exerc. 35 (8), 1381–1395 (Aug).
Diener, E., Emmons, R.A., Larsen, R.J., Griffin, S., 1985. The satisfaction with life scale. J. Pers. Assess. 49 (1), 71–75 (Feb).
Diener, E., Inglehart, R., Tay, L., 2013. Theory and validity of life satisfaction scales. Soc. Indic. Res. 112 (3), 497–527 (Jul).
Dolan, P., Peasgood, T., White, M., 2008. Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. J. Econ. Psychol. 29 (1), 94–122 (Feb).
Eisinger-Watzl, M., Wittig, F., Heuer, T., Hoffmann, I., 2015. Customers purchasing organic food - do they live healthier? Results of the German National Nutrition Survey II. Eur. J. Nutr. Food Saf. 5 (1), 59–71 (Jan 10).
Estaquio, C., Kesse-Guyot, E., Deschamps, V., et al., 2009. Adherence to the French Programme National Nutrition Santé Guideline Score is associated with better nutrient intake and nutritional status. J. Am. Diet. Assoc. 109 (6), 1031–1041 (Jun).
Feller, S., Teucher, B., Kaaks, R., Boeing, H., Vigl, M., 2013. Life satisfaction and risk of chronic diseases in the European prospective investigation into cancer and nutrition (EPIC)-Germany study. PLoS ONE 8 (8), e73462 (août).
Goetzke, B., Nitzko, S., Spiller, A., 2014. Consumption of organic and functional food. A matter of well-being and health? Appetite 77, 96–105 (juin).
Grant, N., Wardle, J., Steptoe, A., 2009. The relationship between life satisfaction and health behavior: a cross-cultural analysis of young adults. Int. J. Behav. Med. 16 (3), 259–268 (Sep).

Hagströmer, M., Oja, P., Sjöström, M., 2006. The International Physical Activity Questionnaire (IPAQ): a study of concurrent and construct validity. Public Health Nutr. 9 (06) Available from: http://www.journals.cambridge.org/abstract_S1368980006001261 (Sep, Internet, cited 2016 Apr 28).
Hallal, P.C., Victora, C.G., 2004. Reliability and validity of the International Physical Activity Questionnaire (IPAQ). Med. Sci. Sports Exerc. 36 (3), 556 (Mar).
Hercberg, S., Castetbon, K., Czernichow, S., et al., 2010. The Nutrinet-Santé Study: a web-based prospective study on the relationship between nutrition and health and determinants of dietary patterns and nutritional status. BMC Public Health 10, 242.
Honkanen, P., Verplanken, B., Olsen, S.O., 2006. Ethical values and motives driving organic food choice. J. Consum. Behav. 5 (5), 420–430 (Sep).
Huber, M., Rembiałkowska, E., Średnicka, D., Bügel, S., van de Vijver, L.P.L., 2011. Organic food and impact on human health: assessing the status quo and prospects of research. NJAS Wagening J. Life Sci. 58 (3–4), 103–109 (Dec).
Hughner, R.S., McDonagh, P., Prothero, A., Shultz, C.J., Stanton, J., 2007. Who are organic food consumers? A compilation and review of why people purchase organic food. J. Consum. Behav. 6 (2–3), 94–110 (Mar).
Husaini, B.A., Neff, J.A., 1980. Characteristics of life events and psychiatric impairment in rural communities. J. Nerv. Ment. Dis. 168 (3), 159–166 (Mar).
Insee, 2015. Définitions, méthodes et qualité - unité de consommation. Available from: http://www.insee.fr/fr/methodes/default.asp?page=definitions/unite-consommation.htm (Internet, cited 2016 Aug 23).
Kesse-Guyot, E., Castetbon, K., Touvier, M., Hercberg, S., Galan, P., 2010. Relative validity and reproducibility of a food frequency questionnaire designed for French adults. Ann. Nutr. Metab. 57 (3–4), 153–162.
Kesse-Guyot, E., Péneau, S., Méjean, C., et al., 2013. Profiles of organic food consumers in a large sample of French adults: results from the Nutrinet-Santé cohort study. PLoS ONE 8 (10), e76998 (Oct 18).
Kim, E.S., Park, N., Sun, J.K., Smith, J., Peterson, C., 2014. Life satisfaction and frequency of doctor visits. Psychosom. Med. 76 (1), 86–93 (Jan).
Koivumaa-Honkanen, H., Honkanen, R., Viinamäki, H., Heikkilä, K., Kaprio, J., Koskenvuo, M., 2001. Life satisfaction and suicide: a 20-year follow-up study. Am. J. Psychiatry 158 (3), 433–439 (Mar 1).
Kummeling, I., Thijs, C., Huber, M., et al., 2008. Consumption of organic foods and risk of atopic disease during the first 2 years of life in the Netherlands. Br. J. Nutr. 99 (03) (Available from: http://www.journals.cambridge.org/abstract_S0007114507815844, Mar, Internet, cited 2016 Nov 15).
Lassale, C., Péneau, S., Touvier, M., et al., 2013. Validity of web-based self-reported weight and height: results of the Nutrinet-Santé study. J. Med. Internet Res. 15 (8), e152 (Aug 8).
de Magistris, T., Gracia, A., 2008. The decision to buy organic food products in Southern Italy. Br. Food J. 110 (9), 929–947 (Sep 5).
Morin, A.J.S., Moullec, G., Maïano, C., Layet, L., Just, J.-L., Ninot, G., 2011. Psychometric properties of the Center for Epidemiologic Studies Depression Scale (CES-D) in French clinical and nonclinical adults. Rev. DÉpidémiol. Santé Publique 59 (5), 327–340 (Oct).
Nutrinet-Santé, E., 2013. Table de composition des aliments de l'étude Nutrinet-Santé. Paris Econ. 296 p.
Oates, L., Oates, L., 2013. Health, wellness and organic diets. Available from: https://researchbank.rmit.edu.au/view/rmit:160443 (cited 2016 Oct 21).
Organic Agriculture Why is organic food more expensive than conventional food? Available from: http://www.fao.org/organicag/oa-faq/oa-faq5/en/ (Internet, cited 2016 Jun 3).
Padilla Bravo, C., Cordts, A., Schulze, B., Spiller, A., 2013. Assessing determinants of organic food consumption using data from the German National Nutrition Survey II. Food Qual. Prefer. 28 (1), 60–70 (avril).
Pavot, W., Diener, E., 1993. Review of the satisfaction with life scale. Psychol. Assess. 5 (2), 164–172.
Pino, G., Peluso, A.M., Guido, G., 2012. Determinants of regular and occasional consumers' intentions to buy organic food. J. Consum. Aff. 46 (1), 157–169 (Mar 1).
Prada, M., Garrido, M.V., Rodrigues, D., 2017. Lost in processing? Perceived healthfulness, taste and caloric content of whole and processed organic food. Appetite 114, 175–186 (Jul 1).
Reganold, J.P., Wachter, J.M., 2016. Organic agriculture in the twenty-first century. Nat. Plants 2 (2), 15221 (Feb 3).
Rembiałkowska, E., Kazimierczak, R., Średnicka, D., Bieńko, K., Bielska, M., 2008. Different aspects of organic and conventional food consumers lifestyle. New Med. 1, 16–19. Available from: http://www.czytelniamedyczna.pl/1049,different-aspects-of-organic-and-conventional-food-consumers-lifestyle.html (Jan 16, Internet, cited 2017 Aug 29).
Ruiz de Santiago y Nevarez, D., 2016. Association Between Diet and Life Satisfaction in Finnish Elderly Women.
Schnettler, B., Miranda, H., Lobos, G., et al., 2015. Eating habits and subjective well-being. A typology of students in Chilean state universities. Appetite 89, 203–214 (juin).
Shafer, A.B., 2006. Meta-analysis of the factor structures of four depression questionnaires: Beck, CES-D, Hamilton, and Zung. J. Clin. Psychol. 62 (1), 123–146 (Jan 1).
Strassner, C., Cavoski, I., Di Cagno, R., et al., 2015. How the organic food system supports sustainable diets and translates these into practice. Front. Nutr. 2 Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4484336/ (Jun 29, Internet, cited 2016 May 12).
Torjusen, H., Brantsæter, A.L., Haugen, M., et al., 2010. Characteristics associated with organic food consumption during pregnancy; data from a large cohort of pregnant women in Norway. BMC Public Health 10 (1) (Dec). Available from: http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-10-775 (Internet, cited 2017 Aug 29).
Torjusen, H., Lieblein, G., Næs, T., Haugen, M., Meltzer, H.M., Brantsæter, A.L., 2012. Food patterns and dietary quality associated with organic food consumption during pregnancy; data from a large cohort of pregnant women in Norway. BMC Public Health 12 (1) (Dec). Available from: http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-12-612 (cited 2017 Aug 29, Internet).
Touvier, M., Méjean, C., Kesse-Guyot, E., et al., 2010. Comparison between web-based and paper versions of a self-administered anthropometric questionnaire. Eur. J. Epidemiol. 25 (5), 287–296 (May 1).
Venhoeven, L.A., Bolderdijk, J.W., Steg, L., 2013. Explaining the paradox: how pro-environmental behaviour can both thwart and foster well-being. Sustainability 5 (4), 1372–1386 (Mar 25).
Vergnaud, A.-C., Touvier, M., Méjean, C., et al., 2011. Agreement between web-based and paper versions of a socio-demographic questionnaire in the NutriNet-Santé study. Int. J. Public Health 56 (4), 407–417 (Aug 1).
Wn, S., 1984. Predicting basal metabolic rate, new standards and review of previous work. Hum. Nutr. Clin. Nutr. 39 (Suppl. 1), 5–41 (Dec).