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Dietary behaviours of individuals with Lynch syndrome at high risk of colorectal cancer: results from the AAS-Lynch study

Noémie Demaré^{1,2}, Chantal Julia^{1,3}, Alice Bellicha^{1,4}, Mourad Benallaoua², Amal Ait Omar², Nathalie Arnault¹, Robert Benamouzig^{2*}, Mélanie Deschasaux-Tanguy^{1,4*} and AAS-Lynch study group 2022

*Co-last authors

¹ Sorbonne Paris Nord University, INSERM U1153, INRAE U1125, CNAM, Nutritional Epidemiology Research Team (EREN), Epidemiology and Statistics Research Center – University Paris Cité (CRESS), Bobigny, France

² Gastroenterology and Oncology Department, Avicenne Hospital, Assistance Publique-Hôpitaux de Paris (AP-HP), Bobigny, France;

³ Public Health Department, Avicenne Hospital, Assistance Publique-Hôpitaux de Paris (AP-HP), Bobigny, France

⁴ Nutrition physical Activity Cancer Research Network (NACRe Network), Jouy-en-Josas, France;

Key words: Lynch syndrome, Nutrition, Dietary pattern, Eating habits, Colorectal cancer

Correspondence to: Noémie Demaré, Gastroenterology and Oncology Department, Avicenne Hospital, Assistance Publique-Hôpitaux de Paris (AP-HP), 125 rue de Stalingrad 93000 Bobigny, France

Tel : +33 1 48 95 50 84 (E-mail : noemie.demare@aphp.fr)

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Abstract

Background & Aims: Individuals with Lynch syndrome (LS) have a high lifetime risk of developing colorectal cancer (CRC) due to genetic alterations. Nutrition is one of the main modifiable risk factors for sporadic CRC, however this has not been established in LS patients. The present study aimed to give a detailed overview of dietary intakes in individuals with LS, and associated individual characteristics.

Methods: Dietary behaviours of individuals with LS from the AAS-Lynch clinical trial (2017-2022) were obtained using a food frequency questionnaire. Dietary intakes, food group consumption and overall diet quality (dietary patterns, adherence to the Mediterranean diet) were described according to sociodemographic, anthropometric and clinical characteristics, and compared to participants without LS from the NutriNet-Santé study (matched on sex, age, BMI and region).

Results: 280 individuals with LS were included in this analysis and matched with 547 controls. Compared to controls, LS patients consumed less fibre, legumes, fruit and vegetables and more red and processed meat (all $p < 0.01$). They also had a lower Mediterranean diet score ($p = 0.002$). Among LS patients, men, younger patients, or those with disadvantaged situation had a diet of poorer nutritional quality with lower adherence to a "Healthy" diet (all $p \leq 0.01$). LS Patients with prevalent CRC had a higher consumption of dairy products than recommended, while those with prevalent adenoma consumed more vegetables, and less sugar and sweets (all $p \leq 0.01$).

Conclusions: Although patients with LS were aware of their high lifetime risk of developing cancer, their diets were not optimal and included nutritional risk factors associated to CRC.

The study is registered with # NCT04791644 at ClinicalTrials.gov.

Key words: Lynch syndrome, Nutrition, Dietary pattern, Eating habits, Dietary recommendation, Cancer prevention, Colorectal cancer, Hereditary Cancer, Risk reduction, Nutritional prevention

Introduction

Lynch syndrome (LS) is an autosomal dominant genetic disorder associated with an increased lifetime risk of developing various digestive and extra-digestive cancers. LS results from germline mutation or deletion in mismatch repair (MMR) genes (MLH1, MSH2, MSH6, PMS2, and EPCAM) and is the most common hereditary colorectal cancer (CRC) syndrome, affecting 1 in 279 individuals in Western countries.(1) Several studies have estimated that individuals with LS have 11 to 79 % cumulative risk to develop a CRC by age 70, depending on the type of gene alteration and sex.(2–5) In comparison, the risk of developing CRC for the general population aged 50-74 years has been estimated at 3.5 %.(6)

Nutrition is one of the main modifiable drivers of colorectal carcinogenesis with 22.4 % (7) of CRC cases attributable to diet. According to the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) 2018 report, strong convincing evidence showed that body fatness and high consumption of alcohol and processed meat increases the risk of CRC while physical activity decreases CRC risk. In turn, there is probable evidence that adopting “Healthy” dietary habits and in particular increasing the intake of wholegrains, food containing dietary fibres, dairy products and calcium, while limiting red meat intake significantly lower this risk.(8) In line with this evidence, several studies observed a lower risk of CRC associated with a higher overall diet quality assessed through adherence to the Mediterranean diet(9), a “Healthy” dietary pattern(10) or to nutritional recommendations (e.g., the French Nutrition and Health Program, PNNS) (11). Among individuals with LS, smoking (12–14), alcohol (15,16) body mass index (BMI) (13,17) or physical activity (18,19), i.e. modifiable factors influencing CRC risk in the general population, appear to be associated with CRC risk. Regarding diet, results on the impact of dietary habits and dietary pattern on CRC carcinogenesis in LS are heterogeneous.(20–23) However, there is considerable phenotypic variability in carriers of the same MMR mutation, as well as in disease progression and prognosis within a family with the same mutation, suggesting the influence of environmental factors, and potentially diet.(24)

Changes in diet and lifestyle have been identified following a cancer diagnosis.(25–27) Because of their very high risk of developing CRC and the presence of a family history of cancer, patient with LS may engage in more favourable dietary behaviours but this has not been established yet.(28) A study by

Burton and al. suggested rather the opposite, with 50% of individuals with LS that did not report worrying about their diet.(29) In order to improve the nutritional management of individuals with LS, it is essential to assess their dietary behaviours and to identify groups exposed to nutritional risk factors for CRC.

To our knowledge, no study in France has reported a detailed overview of the dietary habits of people with LS, including the overall quality of their diet and an assessment of their adherence to nutritional recommendations. The objective of our study was therefore to assess the dietary intake of people with LS and to analyse the characteristics of those adopting dietary behaviours known to be associated with a higher or lower risk of CRC in the general population.

Materials and Methods

Study population

Individuals with LS evaluated in this study were volunteers included in the AAS-Lynch study “Effect of Chemoprevention by Low-dose Aspirin of New or Recurrent Colorectal Adenomas in Patients with Lynch Syndrome” which is a prospective, double-blind, randomized, controlled, multicentre clinical trial designed to assess the effect of daily low doses of aspirin (300 or 100 mg) during 4 years on the occurrence and/or recurrence of colorectal neoplasia in patients with LS (22). Trial recruitment started in 2017 and ended in June 2022. Individuals with LS aged 18 to 75 years with a characterized alteration of MMR genes or with a family history of LS according to modified Amsterdam criteria (30) and having undergone a colonoscopy within 180 days before inclusion were eligible. Exclusion criteria included total colectomy, adenomatous polyposis associated with known alteration of APC or MYH genes or patients with a diagnosis of cancer or receiving cancer treatment at the time of inclusion. In this study, we used dietary data collected as part of “AAS-Lynch Microbiote”, an ancillary study to the AAS-Lynch trial. The AAS-Lynch Microbiote study was approved by the ethics committee of the investigating centre, Avicenne hospital (CLEA-2020-159). The study is registered with # NCT04791644 at ClinicalTrials.gov.

Data collection at inclusion

At inclusion, the patient's personal history (including genetic test results, characteristics of LS, previous colonoscopy results) and family history of cancer were collected from medical records. Colonoscopy was performed within 180 days before inclusion to assess and resect if needed any pre-existing lesions. Patients also completed self-administered questionnaires related to dietary intakes (see below) and socio-demographic and lifestyle characteristics (smoking status, alcohol consumption), including the EPICES (Evaluation of precariousness and health inequalities in health examination centres) questionnaire to detect and quantify precariousness based on socio-economic, behaviour and health indicators.(31) Anthropometric data (height and weight) were measured by trained staff under standardized conditions.

Dietary assessment

Dietary intakes were assessed at inclusion using the semi-quantitative food frequency questionnaire (FFQ) SU.VI.MAX 2.(32) This validated questionnaire, adapted to French eating habits, assesses usual dietary intakes over the past year. Patients documented their frequency of consumption for each of the 240 food and beverage items. For food categories which are usually not eaten in a predetermined serving size (cheese, pâté, fish, meat, butter used on bread, potatoes, cereal products, vegetables, nuts), they were asked to indicate their usual portion size using 3 photographs and 7 intermediate portion sizes. Completed questionnaires were reviewed by a dietician and completed in case of invalid dietary data (missing information and misfiling) by contacting the patients (details are available in Supplementary Methods). Average daily energy, alcohol, macro- and micronutrient intakes were estimated from the SU.VI.MAX food composition table by multiplying consumption frequency by serving size for each food and beverage.(33)

Comparison with non-LS adults from the NutriNet-Santé study

The eating habits of individuals with LS were compared to eating habits of matched non-LS controls from the NutriNet-Santé cohort.(34) NutriNet-Santé is an observational web-based study launched in France in May 2009 with more than 173 000 registered volunteers with the aim to investigate the relationships between nutrition and health. At inclusion and then annually, participants complete

questionnaires on their diet, physical activity, health status (reported health events are validated based on medical records), anthropometric and socio-demographic data. During follow-up, participants are regularly asked to answer additional questionnaires. In 2018, participants completed a FFQ including 264 food and beverage items.(35) This validated FFQ was based on the FFQ that has been used in the AAS-Lynch study, with the vast majority of items being identical between the two FFQs. NutriNet-Santé was approved by the Institutional Review Board of the French Institute for Health and Medical Research and by the National Commission on Informatic and Freedom. The cohort is registered with # NCT03335644 at ClinicalTrials.gov.

For each patient included in the AAS-Lynch study, two participants from the NutriNet-Santé study with complete dietary data from the FFQ and without LS or without any family or personal history of cancer, personal history of colonic polyp or oncologic follow up were selected as controls. NutriNet-Santé participants were matched to individuals with LS based on sex, geographical region of residence, age (+/- 2 years), BMI (+/- 2 kg/m²) and the year of completion of the FFQ (+/- 2 years). Overall 39 out of 547 controls were selected with less stringent matching criteria. (Details are available in Supplementary Methods).

Statistical analyses

The eating habits of individuals with LS were described as food group consumption, energy, alcohol, macro- and micronutrient intakes, a posteriori dietary patterns and as adherence to the Mediterranean diet (36). Macro and micronutrient intakes were compared to the European Food Safety Authority's (EFSA) sex and age-specific dietary reference values.(37) (Supplementary Methods). As regards food group consumption, adherence to the most recent French dietary guidelines (PNNS 4, 2017 (38)) (yes/no), which encompass cancer nutrition recommendations issued by the WCRF/AICR (8) adapted to French nutritional specificities (8), was assessed for 6 'promotion' recommendations related to fruits and vegetables, nuts, legumes, whole grain products, milk and dairy products, fish and seafood and 7 'moderation' recommendations related to alcohol, red meat, processed meat, added fat, sugary foods, sweet-tasting beverages, salt (Supplementary Methods).(38,39) Adherence to the Mediterranean diet was assessed using the MEDI-LITE score (36), which attributes points to low, moderate and high

consumption of 9 food components that are typical or not typical of the Mediterranean diet (Supplementary Methods). A posteriori dietary patterns were derived from a principal component analysis (PCA) on the daily consumption of food and beverages categorized into 20 main food groups. Two factors were retained based on the observation of the eigenvalues (measure of the amount of variance explained by each principal axis), the scree plot and interpretability. Orthogonal varimax rotation was used to maximise the independence of these 2 factors. Food groups with a loading coefficient $\geq |0.20|$ were considered as characterizing the factor and led to identify a “Healthy” pattern and a “Western” pattern (Supplementary Methods).

Comparison of food consumption, nutrient intakes and adherence to dietary guidelines between individuals with LS and NutriNet-Santé participants was performed using Student t-tests, Wilcoxon test and Pearson's chi-squared test, as appropriate. Among patients with LS, differences in eating habits according to sociodemographic, anthropometric and clinical characteristics were assessed using analysis of covariance (ANCOVA, for continuous dependent variables), logistic regression (for dichotomous dependent variables) or multinomial logistic regression (for dependent variables with >2 categories) models including the following covariates: age (20-40, 40-54 and 55-73 years old), sex, smoking status (never smokers, former smokers, current smokers), energy intake (kcal/d, continuous), body mass index (<18.5, 18.5-24.9, 25.0-29.9 and >29.9 kg.m⁻²), precarity (yes/no), personal history of cancer remission (no, yes: CRC, yes: extra-colic cancer) or colorectal adenoma (yes/no). No significant associations were found with the presence of a partial colectomy, severe anxiety, high blood pressure, a family history of cancer or the inclusion centre. Other comorbidities such as diabetes, metabolic syndrome, hyperthyroidism, peptic ulcer disease or hyperlipidemia were present in a very small number of patients and were not associated with the dietary variables.

For all covariates, ≤ 5 % of their values were missing and were imputed to the mean and mode values for continuous and categorical variables respectively.

All tests were two-sided with $p < 0.05$ was considered statistically significant. Statistical analyses were performed using SAS software (version 9.4; SAS Institute Inc.).

Results

Between November 2017 and May 2022, 316 individuals with LS completed the FFQ. Patients were excluded because of missing data and misfiling (n=34) or missing clinical data (n=2). A total of 280 patients were thus included in this analysis, with a mean age (SD) of 48.0 (11.6) years (range: 20-73 years), 51.4 % of women and a mean (SD) BMI of 25.4 (4.6) kg/m². Active smoking was found in 14.6 % of individuals and 13.9 % were in a disadvantaged situation. More than half of patients had a history of colorectal adenoma (52.1 %) and 39.6 % had a history of cancer (**Table1**). In all, 276 patients with LS were matched with 547 participants from the NutriNet-Santé study (details are available in Supplementary Table 1).

Table 2 displays dietary intakes (food groups and nutrients) and adherence to the recommendations for individuals with LS and NutriNet-Santé participants.

Compared to NutriNet-Santé participants, patients with LS reported lower adherence to dietary recommendations, including lower intakes of fruit (-22 %), vegetables (-22 %) and legumes (-41 %) and higher intakes of red meat (+30 %), processed meat (+41 %), dairy products (+5 %), cake and biscuits (+60 %) and sugar and confectionery (+43 %). These differences in food group consumption were reflected in a lower Mediterranean diet adherence score (MEDI-LITE score) in individuals with LS (9.3 vs 9.9, p=0.002). Looking at macro and micronutrient intakes, patients with LS consumed lower amounts of dietary fibres (-15 %), α -Linolenic acid (ALA) (-50 %), iron (-24%), , vitamin E (-21 %), vitamin C (-15 %), vitamin B9 (-18 %) and higher intake of sodium (+24 %). Consistently, adherence to reference values for these nutrients was lower. No differences were found regarding consumption of nuts, fish, fried products and alcoholic drinks or the intakes of energy, alcohol, calcium.. The results of the paired analyses were identical (data not shown).

Table 1: Description of characteristics of LS patients (AAS-Lynch study, n=280)

AAS-Lynch (n=280)			
		n	%
Gender			
	Male	136	48.6
	Female	144	51.4
Age (years)			
	[20-40[	76	27.1
	[40-55[	118	42.1
	[55-73[	86	30.7
Body Mass Index (kg/m²)			
	<25	142	50.7
	[25-30]	99	35.4
	>30	39	13.9
Smoking status			
	Non-smoker	141	50.4
	Former smoker	98	35.0
	Smoker	41	14.6
Situation of precariousness			
	No	241	86.1
	Yes	39	13.9
History of colorectal adenoma			
	No	134	47.9
	Yes	146	52.1
History of cancer			
	No	169	60.4
	Colorectal cancer	57	20.4
	Extra-colic cancer	54	19.3
History of partial colectomy			
	No	256	91.4
	Yes	24	8.6
History of severe anxiety			
	No	262	93.6
	Yes	18	6.4
History of high blood pressure			
	No	253	90.0
	Yes	27	10.0

Table 2: Comparison of food group intakes, MEDI-LITE score, nutrients intakes and adherence to reference values between patients with Lynch syndrome (AAS-Lynch study 2017-2022, n=276) and controls (NutriNet-Santé 2009-2022, n=547).

	AAS-Lynch	NutriNet-Santé	p*	AAS-Lynch	NutriNet-Santé	p**
	means (std)			Adherence with reference value / recommendation (%)		
Food group intakes						
Fruit (g/day)	211.3 (1723.0)	270.0 (235.9)	0.0001	51.8	68.6	<0.0001
Vegetable(g/day)	266.1 (185.0)	341.7 (215.8)	<0.0001			
Legume (g/day)	14.2 (19.8)	24.1 (39.6)	0.006	37.0	41.5	0.21
Unsalted nuts (g/day)	6.6 (9.9)	7.5 (13.9)	0.29	19.9	20.3	0.90
Bread, pasta, rice (g/day)	223.2 (112.1)	204.2 (165.1)	0.04	/	/	/
Potato (g/day)	25.2 (23.7)	18.3 (18.5)	<0.0001	/	/	/
Red Meat (g/day)	71.2 (55.6)	54.6 (53.6)	<0.0001	61.2	72.8	<0.001
Processed Meat (g/day)	43.9 (32.7)	31.0 (27.1)	<0.0001	21.7	44.8	<0.0001
Fish (g/day)	43.3 (39.5)	50.7 (52.6)	0.38	23.6	16.6	0.02
Oily fish (g/day)	18.7 (20.8)	27.2 (31.8)	<0.001	42.8	33.5	0.009
Dairy product (g/day)	309.5 (227.5)	295.8 (313.2)	0.04	26.8	20.5	0.04
Cake and biscuit (g/day)	57.9 (63.3)	36.5 (35.3)	<0.0001			
Sugar and confectionery (g/day) ^a	56.5 (54.6)	39.5 (34)	<0.0001	85.1 ^b	98.5 ^b	<0.0001
Fried product	14.5 (18.0)	13.8 (17.5)	0.11	/	/	/
Rich in ALA or olive oil	9.8 (9.2)	17.1 (15.2)	<0.0001	73.9	66.3	0.03
Sweet beverage (g/day)	183.5 (257.6)	124.4 (168.8)	0.001	80.7	82.3	0.44
Alcohol drink (g/day)	89.1 (106.2)	100.9 (163)	0.81	84.4	84.1	0.90
Salt	8.2 (3.1)	6.7 (3.3)	<0.0001	21.1	46.6	<0.0001
MEDI-LITE score	9.3 (2.5)	9.9 (2.8)	0.002			
Nutrient intakes						
Total intake energy (kcal/day)	2181.2 (729.9)	2161.5 (925.6)	0.74	-	-	-
Proteins (g/day)	96.9 (34.9)	96.4 (46.1)	0.86	7.6	8.8	0.57
Carbohydrates (g/day)	219.6 (82.2)	203.0 (93.2)	0.009	25.7	15.2	<0.001
Fibres (g/day)	20.7 (8.3)	24.5 (12.2)	<0.0001	26.1	38.2	<0.001
Lipids (g/day)	95.9 (38.4)	100.2 (49.8)	0.17	24.6	15.5	0.002
Saturated Fatty Acids (g/day)	37.8 (17.0)	36.3 (19.8)	0.28	3.3	5.9	0.11
Linoleic acid (g/day)	11.5 (5.8)	13.9 (9)	<0.0001	32.6	18.7	<0.0001
α -Linolenic acid (g/day)	1.2 (0.7)	2.4 (2)	<0.0001	25.7	90.0	<0.0001
Eicosapentaenoic acid (g/day)	0.1 (0.1)	0.2 (0.2)	<0.0001	61.2	64.9	0.30
Docosahexaénoïque acid (g/day)	0.3 (0.2)	0.3 (0.3)	0.61			
Alcohol (g/day)	7.5 (9.4)	7.9 (10.9)	0.58	84.3	84.1	0.94
Sodium (mg/day)	3294.5 (1259.3)	2679.8 (1304.0)	<0.0001	9.1	29.3	<0.0001
Calcium (mg/day)	1182.0 (512.4)	1173.5 (599.5)	0.83	58.3	59.6	0.73
Iron (mg/day)	12.3 (4.1)	16.4 (7.2)	<0.0001	54.4	77.2	<0.0001
Potassium (mg/day)	3241.6 (1120.8)	3906.6 (1535.6)	<0.0001	33.7	57.6	<0.0001
Magnesium (mg/day)	344.2 (108.3)	519.3 (225.1)	<0.0001	51.5	84.1	<0.0001

Phosphorus (mg/day)	1454.2 (535.7)	1569.8 (717)	<0.01	99.6	98.7	0.21
Iodine (mg/day)	155.4 (56.1)	272.4 (427.5)	<0.0001	44.9	64.4	<0.0001
Retinol (µg/day)	681.0 (504.9)	559.7 (454.6)	<0.001	35.9	20.3	<0.001
Vitamin D (mg/day)	3.8 (2.9)	3.4 (2.5)	0.02	1.5	0.7	0.32
Vitamin E (mg/day)	12.5 (6.0)	16.0 (9.2)	<0.0001	48.6	64.0	<0.001
Vitamin C (mg/day)	126.2 (77.6)	148.2 (83.2)	<0.001	57.6	67.5	0.006
Vitamin B1 (mg/day)	1.4 (0.5)	1.5 (0.7)	0.001	100	100	1,00
Vitamin B2 (mg/day)	1.9 (0.7)	2.4 (1.2)	<0.0001	61.2	78.8	<0.0001
Vitamin B3 (mg/day)	19.7 (6.9)	26.4 (12.2)	<0.0001	100	100	1,00
Vitamin B5 (mg/day)	6.6 (3.9)	6.8 (2.9)	0.48	62.7	76.1	<0.001
Vitamin B6 (mg/day)	1.9 (0.7)	2.2 (1)	<0.001	60.0	70.9	0.001
Vitamin B9 (µg/day)	352.5 (151.1)	430.8 (199.5)	<0.0001	55.1	73.5	<0.0001
Vitamin B12 (µg/day)	6.8 (4.5)	6.7 (4.4)	0.71	81.2	71.8	0.004

-: Adherence to the EFSA reference value was not assessed for energy intake as physical activity levels were not available

/: There are no recommendations for these dietary intakes

a: Sugar and confectionery: sugar, honey, jam, spread, chocolate, candy, dessert cream and ice cream

b: Recommendation for sweet products: sugar, honey, jam, spread, chocolate, candy, dessert cream, ice cream, cake and biscuit

c: MEDI-LITE score ranges from 0 to 18

*: p-values derived from a Student t-tests or Wilcoxon test

** : p-values derived from a Pearson's chi-squared test

Table 3: Nutrients intakes of patients with Lynch syndrome according to individual characteristics, AAS-Lynch study 2017-2022.

Nutrients Intakes*	Sex			Age (years)				BMI (kg/m ²)				Smoking status				Situation of precariousness			History cancer				History colorectal adenoma		
	Men	Women	p*	[20-40[	[40-55[	[55-73[	p*	<25	[25-30]	>30	p*	Non-smoker	Former smoker	Smoker	p*	No	Yes	p*	No	CRC	Extra-colic cancer	p*	No	Yes	p*
Total intake energy (kcal/day)	2436	2139	0.002	2344	2293	2225	0.63	2278	2198	2387	0.43	2189	2358	2316	0.22	2305	2271	0.80	2222	2205	2436	0.16	2309	2266	0.65
Proteins (g/day)	99.9	99.9	0.99	100.3	100.0	99.3	0.93	97.1	100.7	101.8	0.17	100.2	101.1	98.2	0.68	97.8	101.9	0.17	99.9	97.7	102.0	0.43	99.0	100.7	0.44
Animal proteins (g/day)	74.7	74.6	0.98	75.2	74.9	73.8	0.90	72.3	76.0	75.6	0.31	75.0	75.9	72.9	0.72	71.0	78.2	0.03	74.2	71.9	77.9	0.26	74.2	75.1	0.69
Vegetable proteins (g/day)	25.2	25.3	0.96	25.1	25.1	25.4	0.94	24.8	24.7	26.2	0.44	25.2	25.2	25.3	1.00	26.8	23.7	0.01	25.7	25.8	24.1	0.25	24.9	25.6	0.37
Carbohydrates (g/day)	217.9	209.8	0.16	212.3	212.8	216.4	0.82	214.2	209.9	217.4	0.65	215.3	207.7	218.6	0.33	221.0	206.7	0.07	221.0	216.0	204.5	0.07	216.2	211.5	0.40
Simple carbohydrates (g/day)	97.4	102.5	0.26	95.7	99.7	104.5	0.33	103.4	102.2	94.4	0.41	103.1	96.0	100.9	0.34	105.1	94.9	0.11	103.5	99.2	97.3	0.48	102.5	97.5	0.27
Fibres (g/day)	18.2	20.0	0.02	17.5	19.0	20.9	0.01	19.3	18.9	19.1	0.90	19.7	19.6	18.1	0.37	20.6	17.7	0.01	19.5	19.7	18.2	0.42	18.5	19.7	0.14
Lipids (g/day)	95.0	101.7	0.001	99.2	99.1	96.8	0.55	99.7	99.8	95.6	0.35	98.6	100.1	96.3	0.45	96.0	100.7	0.10	95.4	97.5	102.2	0.02	97.8	98.9	0.61
SFA (g/day)	38.5	39.7	0.29	39.2	39.5	38.5	0.72	39.9	39.3	38.0	0.47	39.0	39.7	38.6	0.75	37.9	40.2	0.12	37.6	38.4	41.2	0.03	38.4	39.8	0.19
MUFA (g/day)	36.5	39.9	>0.001	38.8	38.6	37.3	0.36	38.7	38.8	37.2	0.52	38.3	39.2	37.2	0.38	37.6	38.9	0.35	37.2	37.9	39.6	0.13	38.4	38.1	0.72
PULA (g/day)	13.5	15.5	0.001	14.7	14.4	14.5	0.90	14.4	15.2	13.9	0.33	14.7	14.6	14.2	0.80	14.0	15.1	0.18	14.1	14.6	14.9	0.52	14.5	14.5	0.93
Linoleic acid (g/day)	11.2	12.9	0.003	12.4	11.9	11.9	0.66	12.0	12.6	11.5	0.37	12.2	12.0	11.9	0.89	11.4	12.7	0.07	11.7	12.0	12.4	0.59	12.0	12.1	0.89
α-Linolenic acid (g/day)	1.0	1.2	>0.001	1.0	1.0	1.2	0.05	1.1	1.2	1.0	0.24	1.1	1.2	1.0	0.25	1.2	1.0	0.09	1.0	1.1	1.2	0.06	1.1	1.1	0.86
Eicosapentaenoic acid (g/day)	0.1	0.1	0.74	0.1	0.1	0.2	0.24	0.1	0.1	0.2	0.75	0.1	0.2	0.1	0.50	0.2	0.1	0.14	0.1	0.1	0.1	0.79	0.1	0.1	0.35

Docosahexaénoïque acid (g/day)	0.2	0.2	0.54	0.2	0.2	0.3	0.29	0.2	0.2	0.3	0.78	0.2	0.3	0.2	0.51	0.3	0.2	0.14	0.2	0.2	0.2	0.75	0.3	0.2	0.40
Cholesterol (mg/day)	411.4	407.9	0.76	420.4	408.7	400.0	0.39	412.4	412.5	404.2	0.88	403.1	409.8	416.2	0.69	399.0	420.3	0.18	393.1	438.0	397.9	0.01	418.3	401.1	0.13
Alcohol (g/day)	10.2	6.2	>0.001	7.7	7.8	9.1	0.55	7.8	8.1	8.6	0.89	6.9	8.7	9.0	0.21	8.3	8.1	0.92	7.9	9.3	7.3	0.48	8.0	8.4	0.68
Sodium (mg/day)	3302	3305	0.98	3276	3316	3318	0.94	3310	3197	3403	0.37	3302	3457	3151	0.13	3334	3273	0.67	3269	3303	3339	0.86	3216	3391	0.09
Calcium (mg/day)	1146	1194	0.30	1107	1159	1243	0.08	1173	1168	1168	0.99	1194	1201	1114	0.44	1173	1166	0.92	1170	1081	1259	0.05	1134	1206	0.12
Iron (mg/day)	12	12	0.44	12	12	12	0.24	12	12	12	0.38	12	12	12	0.74	12	12	0.15	12	13	12	0.15	12	12	0.84
Potassium (mg/day)	3014	3208	0.02	2972	3082	3280	0.01	3129	3111	3094	0.95	3195	3178	2961	0.13	3202	3021	0.12	3172	3090	3072	0.53	3056	3167	0.17
Magnesium (mg/day)	330	335	0.45	322	327	349	0.01	331	331	335	0.91	338	344	316	0.06	346	319	0.02	335	334	329	0.86	328	337	0.21
Retinol (µg/day)	674	684	0.85	588	726	725	0.08	750	727	561	0.06	666	741	632	0.30	621	738	0.12	668	622	748	0.30	657	701	0.41
Vitamin E (mg/day)	11	14	>0.001	12	12	13	0.49	12	13	12	0.32	13	12	12	0.66	12	12	0.86	12	12	12	0.95	12	12	0.97
Vitamin C (mg/day)	101	130	0.001	110	112	125	0.31	116	120	112	0.82	124	113	110	0.38	124	107	0.16	118	117	112	0.85	117	114	0.75
Vitamin B1 (mg/day)	1.3	1.3	0.18	1.3	1.4	1.3	0.57	1.3	1.3	1.4	0.08	1.4	1.4	1.2	0.04	1.4	1.3	0.29	1.4	1.3	1.3	0.54	1.3	1.3	0.48
Vitamin B6 (mg/day)	1.9	1.9	0.47	1.8	1.9	1.9	0.42	1.8	1.9	1.9	0.52	1.9	1.9	1.8	0.30	1.9	1.9	0.43	1.9	1.9	1.9	0.93	1.9	1.9	0.35
Vitamin B9(µg/day)	317	361	0.001	315	337	366	0.02	341	345	332	0.83	349	347	322	0.36	349	330	0.30	337	342	340	0.95	327	351	0.07
Vitamin B12(µg/day)	7	7	0.94	6	7	7	0.19	7	7	7	0.79	7	7	7	0.49	7	7	0.59	7	7	7	0.80	7	7	0.96

Abbreviation: BMI: Body Mass Index.

*: Adjusted means and p-values derived from an ANCOVA model adjusted for sex, age, BMI, smoking status, situation of precariousness, history of cancer and history of colorectal adenomas.

Table 4: Food group intakes of patients with Lynch syndrome according to individual characteristics, AAS-Lynch study 2017-2022.

Food Group Intakes	Sex			Age (years)				BMI (kg/m ²)				Smoking status				Situation of precariousness			History cancer				History colorectal adenoma		
	Men	Women	p*	[20-40[	[40-55[	[55-73[	p*	<25	[25-30]	>30	p*	Non-smoker	Former smoker	Smoker	p*	No	Yes	p*	No	CRC	Extra-colic cancer	p*	No	Yes	p*
Fruit (g/day)	154.3	208.6	0.01	134.1	186.8	223.4	0.005	192.0	191.6	160.6	0.57	193.3	190.6	160.3	0.53	198.8	164.0	0.23	184.0	191.5	168.7	0.76	174.4	188.4	0.49
Vegetable (g/day)	211.7	275.7	0.003	209.4	232.3	289.2	0.01	252.4	233.2	245.4	0.69	257.4	256.1	217.6	0.41	263.0	224.4	0.19	239.7	246.1	245.2	0.96	217.7	269.6	0.01
Legume (g/day)	11.1	15.3	0.09	13.4	13.4	12.7	0.97	13.3	14.5	11.7	0.76	13.1	14.5	12.0	0.77	14.3	12.1	0.53	12.4	11.6	15.5	0.55	11.5	14.9	0.18
Nuts (g/day)	4.5	7.4	0.02	5.5	6.4	6.0	0.84	5.5	6.7	5.6	0.67	6.1	6.5	5.2	0.82	7.2	4.6	0.15	5.1	5.5	7.2	0.41	5.8	6.1	0.76
Bread, pasta, rice (g/day)	20.4	16.3	<0.001	24.4	17.4	13.2	0.46	18.2	17.3	19.6	0.06	16.0	16.5	22.6	0.92	14.5	22.2	0.71	20.7	15.9	18.5	0.03	16.4	20.3	0.87
Potato (g/day)	29.2	22.1	0.01	22.7	24.3	29.9	0.09	23.6	22.2	31.1	0.10	23.8	27.1	26.0	0.50	28.5	22.8	0.13	24.9	27.1	24.9	0.80	25.3	26.0	0.78
Red meat (g/day)	80.8	71.9	0.16	76.7	78.8	73.4	0.76	71.7	78.9	78.3	0.52	78.2	76.3	74.4	0.91	69.3	83.3	0.11	76.7	74.6	77.6	0.95	75.5	77.1	0.80
Processed Meat (g/day)	49.5	47.9	0.66	50.2	54.0	41.9	0.02	46.7	44.6	54.8	0.22	49.0	55.0	42.2	0.07	41.3	56.1	0.01	48.7	46.2	51.2	0.69	48.4	49.0	0.87
Fish (g/day)	37.5	42.3	0.48	32.5	37.6	49.6	0.13	38.7	36.5	44.4	0.76	39.2	44.9	35.6	0.61	46.0	33.8	0.20	44.0	40.0	35.8	0.61	41.2	38.6	0.71
Dairy product (g/day)	285.1	306.1	0.43	275.6	294.0	317.4	0.47	306.8	294.0	286.1	0.83	318.8	302.2	265.9	0.38	282.0	309.3	0.46	322.1	247.4	317.5	0.07	288.8	302.5	0.60
Cake and biscuit (g/day)	56.6	56.4	0.98	59.7	59.5	50.4	0.48	59.3	55.8	54.5	0.85	52.2	45.6	71.7	0.06	64.4	48.6	0.11	53.7	62.1	53.7	0.62	59.9	53.1	0.33

Sugar and confectionery (g/day) ^a	50.4	42.9	0.23	42.6	49.8	47.5	0.64	49.2	53.9	36.9	0.22	48.6	51.4	40.0	0.49	52.4	40.9	0.18	49.8	52.4	37.7	0.23	54.9	38.4	0.01
Fried product (g/day)	249.8	205.9	0.04	238.3	221.7	223.4	<0.001	217.6	212.1	253.8	0.75	229.0	224.4	230.1	0.07	224.8	230.8	0.01	244.1	232.8	206.6	0.14	228.7	226.9	0.05
Sweetened soft (g/day)	173.7	217.1	0.15	241.5	185.0	159.7	0.11	161.5	208.3	216.3	0.24	193.8	144.9	247.4	0.07	212.1	178.7	0.43	199.8	188.4	198.0	0.95	219.7	171.1	0.11
Alcohol drinks (g/day)	120.0	69.4	<0.001	92.5	85.7	105.8	0.41	89.7	92.4	102.0	0.82	78.1	108.6	97.5	0.08	102.3	87.1	0.41	87.3	111.4	85.5	0.29	90.5	98.9	0.51
Coffee (ml/day)	192.9	166.8	0.17	166.5	176.2	196.9	0.44	193.4	171.4	174.8	0.51	144.5	195.9	199.2	0.02	206.4	153.3	0.05	185.7	190.4	163.4	0.58	158.8	200.9	0.03
Tea (ml/day)	59.4	237.4	0.002	75.4	196.7	172.9	0.19	228.4	181.6	35.1	0.06	170.0	158.4	116.6	0.80	205.6	91.0	0.14	118.3	179.2	147.4	0.66	189.7	106.9	0.13
MEDI-LITE score	8.92	9.35	0.16	8.82	8.89	9.69	0.04	9.29	9.11	9.01	0.75	9.02	9.01	9.37	0.70	9.13	9.47	8.81	0.37	8.99	9.28	0.34	9.51	8.76	0.08
Dietary Patterns																									
“Western” diet ^b	0.25	0.07	0.02	0.37	0.10	-0.001	<0.001	0.05	0.15	0.27	0.10	0.08	0.15	0.24	0.30	0.06	0.25	0.06	0.16	0.22	0.10	0.57	0.20	0.12	0.24
“Healthy” diet ^c	-0.36	-0.01	0.001	-0.39	-0.21	0.06	0.01	-0.12	-0.20	-0.23	0.71	-0.15	-0.11	-0.29	0.57	0.00	-0.36	0.02	-0.20	-0.11	-0.24	0.74	-0.24	-0.13	0.33

Abbreviation: BMI: Body Mass Index.

*: Adjusted means and p-values derived from an ANCOVA model adjusted for sex, age, BMI, smoking status, situation of precariousness, history of cancer and history of colorectal adenomas.

a: Sugar and confectionery: sugar, honey, jam, spread, chocolate, candy, dessert cream and ice cream.

b: “Western” pattern: loading coefficient $\geq |0.20|$ with red meat, poultry, processed meat, egg, potato, starch without potato, fried products, fats and sauces, cake and biscuits, sugar and confectionery, sweetened and alcohol drinks.

c : “Healthy” patter

n: loading coefficient $\geq |0.20|$ with vegetables, fruits, legumes, egg, fish and seafood, dairy products, breakfast cereals, nuts, fats and sauces and hot drinks.

Focusing on patients with LS, we found in men higher intakes in energy, alcohol, cereal products (bread, pasta, rice, potato) and fried products and in women higher intakes of fibre, lipids (MUFA, PUFA, ALA and LA) vitamin C, E and their food sources, namely fruit and vegetables and nuts. (Table 3 and Table 4) Hence, women were also more likely to meet the recommendations for fruit, vegetables, nuts, alcohol, ALA, vitamin C and E (Supplementary Table S2 and S3). If we look at the overall quality of the diet, men were more likely to consume a “Western” diet.(Table 4) Older age was associated with higher intakes in vegetables, fibres and lower intakes in processed meat and fried products. (Table 3 and Table 4) Their diet scored higher on the MEDI-LITE scale and showed a lower adherence to the “Western” dietary pattern. (Table 4) Former smokers and active smokers had higher intake of coffee and were less likely to follow the alcoholic beverage recommendation. (Table 4 and Supplementary Table S2) Patients with LS in a disadvantaged situation had higher intakes of protein of animal origin, processed meat and fried products, lower intakes of vegetable protein and fibre (Table 3 and 4) and adhered less to the reference values for the ratio olive oil/ALA-rich oil and ALA (Supplementary Table S2 and S3) and to a “Healthy” dietary pattern. (Table 4) Patients with a history of extra-colonic cancer consumed more lipids and SFAs, those with a history of CRC consumed more cholesterol (Table 3) and had a higher adherence to the recommendation for dairy products (Supplementary Table S3). Patients with a history of colorectal adenomas had higher intakes of vegetables and lower intakes of sugar and confectionery. (Table 4) We did not find any significant difference in food consumption, compliance with recommendations or overall diet quality according to BMI.

Discussion

In this study, we provided an extensive overview of dietary behaviours, including food group consumption, nutrient intakes and diet quality, of patients with LS from the AAS-Lynch clinical trial. Our analysis of the dietary habits of these LS patients compared to a non-LS population from the NutriNet-Santé study showed a less favourable nutritional profile, which is associated in the general population with a higher risk of CRC. Furthermore, in our LS population, we distinguished specific groups with potentially risky behaviours with regard to dietary risk factors for CRC.

To the best of our knowledge, this is the first French study to extensively characterize the dietary behaviour of patients with LS, including a comparison with a matched sample from the general non-LS population. The diet of individuals with LS was overall of poorer nutritional quality. Indeed, they consumed less fruit, vegetables, legumes, nuts, and oily fish but more red and processed meat as well as sweet beverage, cake and biscuit, sugar and confectionery. Hence, they also deviated from the characteristics of the Mediterranean diet. At the nutrient level, this was reflected by lower intakes of and adherence to the reference values for dietary fibre, ALA, vitamins including antioxidant vitamins (40) (vitamin C, E, B2, B6 and B9) and minerals (iron, potassium, magnesium, iodine) and a higher sodium intake. Yet, according to the WCRF/AICR, foods containing dietary fibre are likely to be protective against CRC, while the consumption of red and processed meat constitute an established risk factor for CRC.(8) Hence, in this study individuals with LS seemed to adopt more at-risk eating habits as regards CRC, but also more generally to have a more unbalanced diet, with potential consequences for their overall health.(41) Similar results were observed in a study by Vrieling et al which provided an overview of the adherence to the WCRF recommendations for cancer prevention of 114 Dutch individuals with LS.(42) Overall, individuals with LS had very low adherence to the WCRF recommendations for fruit and vegetables (4.4 % vs. 51.8 % in our study reaching ≥ 5 portions/day) and fibre (6.2 % reaching a threshold of ≥ 17 g/day vs 26.1 % in our study reaching a threshold of ≥ 25 g/day).(42) In addition, 40 % of patients reached the threshold of <500 g/week red/processed meat of which processed meat <3 g/day in comparison with our study where 61.2 % and 21.7 % of patients reached the threshold of < 500 g/week for red meat and < 150 g/week for processed meat, respectively.(42) Likewise, a similar adherence of 36 % for the red-and-processed meat WCRF recommendation was observed in another recent study including 211 Dutch patients with LS.(43)

Our study compared LS patients to participants in the NutriNet-Santé cohort as non-LS controls. However, it should be noted that participants in the NutriNet-Santé study were volunteers, with a higher level of education and healthier eating behaviours compared to the general population.(44,45) Hence, this could increase the differences in consumption observed between LS and NutriNet-Santé individuals. Indeed, when comparing our results with the results of the French nationally representative INCA3

survey (n=2121) and Esteban study (n=1627), we observed that patients with LS were more in line with the recommendations for fruit and vegetables and legumes and consumed slightly more dietary fibres.(46,47) However, similar to the comparison with NutriNet-Santé participants, patients with LS were more likely to follow the recommendations for the consumption of dairy products and less likely for the recommendations regarding red or processed meats compared to the general population. Yet, these comparisons are not straightforward due to differences in the tools used to assess dietary intakes (FFQ in our study vs. 24-hour recalls in INCA 3 and Esteban study, which tend to over- and underestimate dietary intakes, respectively(48)), but also differences in the characteristics of the populations (e.g., age, sex, weight status). In contrast, AAS-Lynch and NutriNet-Santé studies used very similar tools to assess dietary intakes and participants were matched to ensure better comparability of the results.

Our study also allowed to identify groups of LS patients with more risky eating behaviours. Indeed, our results showed that men with LS had overall dietary habits more at risk for CRC compared to women. They consumed almost twice as many alcohol and tended to consume a more “Western-like” dietary pattern whose constituents include CRC risk factors (alcohol, red meat and processed meat). Conversely, they were less likely to adhere to a “Healthy” diet that included CRC protective factors (fibre-rich foods and dairy products). These results were similar to those observed in INCA3 survey for the general French population where a higher consumption of alcoholic beverages, meat and processed meat was observed in men while women consumed more yoghurt, cottage cheese, and had higher intakes of fibre, calcium, vitamin C and B9.(47) Younger patients with LS tended to have a less balanced diet, with the consumption of food groups positively associated with CRC risk. This trend was also seen in the general population from INCA3 and Esteban studies where the level of consumption and adherence to the fruit and vegetable recommendation was higher in older subjects.(46) However, unlike the general population where adults aged 65-79 years are more likely to consume alcoholic beverages compared to those aged 18-44 years, we did not observe a significant difference in individuals with LS in terms of consumption or compliance with alcohol recommendations according to age.(47) In addition, individuals with LS in disadvantaged situation were less likely to adhere to a “Healthy” dietary pattern, and their intake in

vegetables, fibre and magnesium was lower. Conversely, their diet contained higher levels of protein of animal origin, processed meat and fried products. Knowing that a high level of precariousness was present among the most disadvantaged social categories and was associated with a lower level of education and instability in employment, our results are consistent with those observed in the French and European populations. (47,49,50) Indeed, a low level of education was associated with a lower intake of fibre, magnesium, vitamin C (49) as well as a lower consumption of fruit, vegetables or dairy products(47,50) and higher protein intake and meat consumption (47,49). People with a low income level also had a lower intake of magnesium, potassium and vitamin C.(49) As observed in the general population, smokers and ex-smokers in LS patients accumulated risk factors for CRC by being less likely to follow the recommendations on alcohol. This correlation between smoking and alcohol consumption has been established in the literature (51) and both factors are associated with the risk of CRC in the general population but also in patients with LS.(14,15,52) In turn, patients with LS with a history of colorectal neoplasia (cancer or adenoma) tended to consume a more balanced diet in terms of nutritional factors associated with CRC, with more vegetables and higher calcium intake and dairy product consumption. Similar results were shown in CRC survivors (n=116) where 33 % reported changes in their dietary habits aimed at coping or reducing the risk of CRC.(53) In the study of Bours et al., 36 % of CRC survivors (n=1458) reported having made “Healthy” dietary changes, among which many were CRC risk factors.(54) Contradictory results were found in patients with LS from a Dutch cohort (n=324) where no significant association was found between the diagnosis of colorectal neoplasia and changes in dietary habits.(28) Similarly, in the study by Hoedjes et al. in 211 Dutch patients with LS, no significant association was found between adherence to WCRF recommendations and having a personal history of cancer.(43) These few differences between patients with and without a history of colorectal neoplasia in our study may be explained by the long average time between the diagnosis of the last cancer and the assessment of dietary habits. In addition, the diagnosis of LS and/or having a first-degree relative with cancer could also lead to a change in dietary behaviour and thus blur the differences in behaviour related to personal cancer history.(55)

Our data indicate that the dietary intakes of patients with LS were not optimal and could therefore benefit from dedicated measure. When interviewed at a conference on LS, individuals with LS and their relatives reported their educational needs and topics of particular interest.(56) Seventy-one percent indicated a need for education in the area of nutrition and its impact on the disease, as well as monitoring and prevention options.(56) Oncogenetic consultations at the time of providing LS testing results may provide a good opportunity to discuss with the patients about preventive measures and nutritional risk and protective factors related to CRC. Although no standardised prevention methods are performed during oncogenetic follow-up, several studies showed that it was possible to promote healthier nutritional behaviours during genetic testing consultations.(56) In addition, nutritional interventions during consultations seem to be the most promising in encouraging behaviour change.(57) More specifically in LS, the provision of awareness materials around the WCRF cancer prevention guidelines has improved patient knowledge, yet with no difference in their adherence to the recommendations.(42)

This study had several strengths. First, the patients were confirmed carriers of MMR mutations from 37 centres across France reflecting a diversity of profiles. Secondly, dietary intakes of patients with LS were compared to volunteers from the NutriNet-Santé study of similar gender, age, BMI and geographical region of residence and using similar dietary assessment tools. Third, dietary data were obtained from a FFQ representative of French consumption habits and validated in the French population, which made it possible to consider the whole diet through daily consumption of foods, nutrient intakes as well as overall dietary patterns. Fourth, clinical and anthropometric data were obtained from medical records or measured by trained staff and were therefore not subject to recall or reporting bias.

However, some limitations should be acknowledged. Although this is the largest study in France on the dietary intakes of patients with LS, our sample size was still limited, which may have hampered our ability to detect associations. In addition, as described above, the higher level of education and healthier eating behaviour of participants in the NutriNet-Santé study(44,45) could increase the differences in consumption observed between LS and NutriNet-Santé individuals. In addition, our FFQ did not assess intakes of wholegrain foods, ultra-processed foods or the absolute value of antioxidant intakes. Still, our

analyses included the intake of some antioxidant vitamins, antioxidant-rich food sources as well as adherence to the Mediterranean diet, whose adherence is associated with a higher level of antioxidant intakes.(58) The level of nutritional education of the participants was not measured through the questionnaire, however the inclusion centre was considered in our analyses and allowed to verify the absence of a “centre” effect (with corresponding care protocols) on dietary consumption. The level of physical activity as well as the socio-economic status (beyond precariousness) were not available at the time of the analysis and thus could not be included in our analyses. Finally, no significant association were found between nutritional intakes and comorbidity. Nutritional intakes could be impacted by other non-cancer comorbidities. In our sample, only a few LS patients had comorbidities such as diabetes, metabolic syndrome, hyperthyroidism, peptic ulcer or hyperlipidemia. Hence these either could not been considered as independent factors in our analyses or were not associated with dietary behaviours. However, we did include BMI categories in our analyses and found no significant difference.

In conclusion, our study provided extensive data on the dietary behaviour of patients with LS. Our data indicate that, although patients with LS were aware of their high lifetime risk of developing cancer, their diets were not optimal and thus could be improved. Our study also showed that among patients with LS, being a man, younger or in a disadvantaged situation was associated with lower diet quality, which is a well-recognized risk factor for CRC. These results may therefore help improve patient stratification and may have important clinical implications. Further steps will be to measure the association between dietary habits and colorectal carcinogenesis in these patients with LS, which will help to identify potential levers to better define nutrition-based prevention strategies in this high-risk population. Finally, a gap analysis conducted in patients with LS and their caregivers could be an interesting approach in order to identify the various gaps in current nutritional prevention strategies and thus have a substantial impact on colorectal cancer management and prevention. (59)

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Contributor's statement

ND : Formal analysis, Methodology, Writing - original draft, Writing - review & editing

CJ : Conceptualization, Methodology, Writing - review & editing

AB : Writing - review & editing

MB : Conceptualization, Funding acquisition, Methodology

AAO : Conceptualization, Funding acquisition, Methodology

NA : Formal analysis

RB : Conceptualization, Funding acquisition, Investigation, Methodology, Supervision, Project administration, Writing - review & editing

MDT : Supervision, Project administration, Writing - review & editing

ALG : Data curation, Funding acquisition, Investigation, Methodology, Validation

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Data sharing:

Data described in the manuscript, code book, and analytic code will be made available upon request pending approval.

Ethics approval and consent to participate

Ethical committee approval under the number 09-2016 was obtained on March 14, 2016.

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Declaration of competing interests:

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analysis, or interpretation of data; and in the writing of the manuscript.

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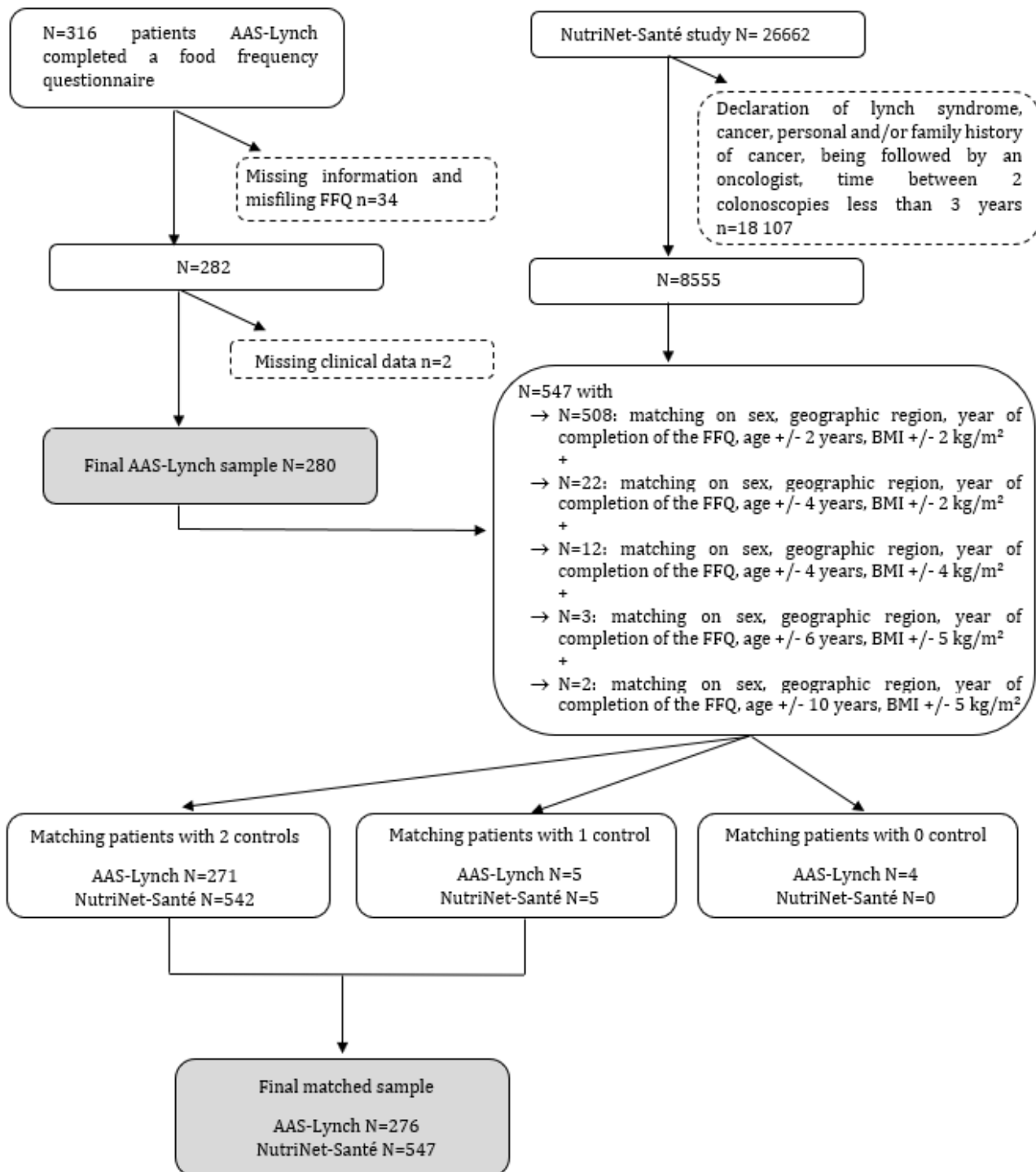
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Supplementary Methods - intended for publication

A) Flow chart of the AAS-Lynch study population selection and matching with population of NutriNet-Santé study



B) Recommendations of PNNS 4 and corresponding indicators used to assess adherence.

Dietary intake	Recommendations	Indicators used
Fruits and vegetables	<i>At least 5 fruits and vegetables a day</i>	≥ 400 g / day
Unsalted nuts	<i>A small handful a day</i>	≥ 10 g / day ^a
Legumes	<i>At least twice a week</i>	≥ 2 / week
Dairy products	<i>2 dairy products per day</i>	2 / day
Meat and poultry	<i>Favour poultry and limit other meats (pork, beef, veal, mutton, lamb, offal) to 500 g per week</i>	< 500 g red meat / week
Fish and sea food	<i>2 times a week, including one oily fish</i>	1.5 - 2.5 / week 0.5 - 1.5 / week
Processed meat	<i>Limit processed meats to 150 g per week</i>	< 150 g / week
Added fats (AF)	<i>AF - oil, butter and margarine - can be consumed daily in small amounts.</i> <i>Choose rapeseed, walnut and olive oil</i>	< 16 % of EIWA AF vegetal origin > AF animal origin AF rich in ALA or olive oil / AF of vegetable origin > 50 %
Sweet Products	<i>Limit the consumption of sweet products</i>	Simple carbohydrates from sweet products < 12.5 % de l'EIWA ^b
Sweet Drinks	<i>Limit the consumption of sweet drinks</i>	consumption of sweet drinks < 250 mL / day
Salt	<i>Reducing salt consumption</i>	6 g / day
Alcohol	<i>Maximum 2 drinks per day and not every day</i>	< 100 g / week

Abbreviation: PNNS: Programme National Nutrition Santé.

a) Use of the same indicator as in the Esteban study: At least one reported consumption during the three 24-hour recall days.

b) Abbreviation: EIWA: Energy intake without alcohol.

C) Dietary reference values from ESFA used to assess adherence.

Nutrient intake	Male	Female
Dietary fibre	25 g/day	
Total carbohydrates	45–60 % of energy	
Protein	0.83 g/kg	
Total fat	20-35 % of energy	
Alpha-linolenic acid (ALA)	0.5 % of energy	
Eicosapentaenoic acid, Docosahexaenoic acid (EPA, DHA)	250 mg/day DHA +EPA	
Linoleic acid (LA)	4 % of energy	
Calcium	1000 mg/day	950 mg/day
Iodine	150 µg/day	
Iron	11 mg/day	16 mg/day
Magnesium	350 mg/day	300 mg/day
Phosphorus	550 mg/day	
Potassium	3500 mg/day	
Sodium	2 g/day	
Thiamin (Vitamin B1)	0.1 mg/MJ	

Riboflavin (Vitamin B2)	1.6 mg/day	
Niacin (Vitamin B3)	1.6 mg NE ^a /MJ	
Pantothenic acid (Vitamin B5)	5 mg/day	
Pyridoxin (Vitamin B6)	1.7 mg/day	1.6 mg/day
Folate (vitamin B9)	330 µg DFE ^b /day	
Cobalamin (vitamin B12)	4 µg/day	
Vitamin A	750 µg RE ^c /day	650 µg RE ^c /day
Vitamin D	15 µg/day	
Vitamin E	13 mg/day	11 mg/day
Vitamin C	110 mg/day	95 mg/day

a) Abbreviation: NE: Niacin Equivalent.

b) Abbreviation: DFE: Dietary Folate Equivalent.

c) Abbreviation: RE: Retinol Equivalent.

D) Computation of the MEDI-LITE score.

Dietary intake	Recommendations	Indicators used		
Fruits	<i>1 portion = 150g</i>	<1 portion/day 0	1-1.5 portions/day 1	>2 portions/day 2
Vegetables	<i>1 portion = 100 g</i>	<1 portion/day 0	1-2.5 portions/day 1	>2.5 portions/day 2
Legumes	<i>1 portion = 70 g</i>	<1 portion/week 0	1-2 portions/week 1	>2portions/week 2
Cereals	<i>1 portion = 130 g</i>	<1 portion/day 0	1-1.5 portions/day 1	>1.5 portions/day 2
Fish	<i>1 portion = 100g</i>	<1 portion/week 0	1-2.5 portions/week 1	>2.5 portions/week 2
Meat and meat products	<i>1 portion = 80 g</i>	<1 portion/day 2	1-1.5 portions/day 1	>1.5 portions/day 0
Dairy products	<i>1 portion = 180 g</i>	<1 portion/day 2	1-1.5 portions/day 1	>1.5 portions/day 0
Alcohol	<i>1 alcohol unit (AU) = 12 g</i>	<1 AU/day 1	1-2 AU/day 2	>2AU/day 0
Olive oil	/	Occasional use ^a 0	Frequent use ^b 1	Regular use ^c 2

Abbreviation: MEDI-LITE: Mediterranean diet based on literature.

a) Occasional use corresponds to the non-users.

b) Frequent use corresponds to the participants with consumption below the median calculated for consumers alone.

c) Regular use corresponds to the participants with consumption above the median calculated for consumers alone.

E) Rotated Component Loadings for the 2 Major Principal Components from an ACP on 20 Food Groups

	Factor1	Factor2
	"Western Diet"	"Healthy Diet"
Vegetables	0.01	0.75
Legumes	0.06	0.62
Fruits	-0.09	0.56
Poultry	0.51	-0.12
Red meat	0.60	-0.11
Processed meat	0.51	-0.18
Fish	0.09	0.70
Egg	0.35	0.29
Starchy without potato	0.48	0.10
Potato	0.49	0.17
Dairy product	0.14	0.36
Breakfast cereal	-0.12	0.37
Cakes biscuits	0.46	0.10
Sugar confectionery	0.45	-0.11
Nuts	-0.03	0.37
Fats and sauce	0.64	0.30
Fried product	0.51	-0.14
Sweetened soft	0.54	-0.12
Alcohol drinks	0.33	0.11
Hot drinks	-0.20	0.22

Supplementary table 1: Comparison of sociodemographic characteristics between patients with Lynch syndrome from the AAS-Lynch study (n=276) and participants from the NutriNet-Santé study (n=547)

	AAS-Lynch		NutriNet-Santé		p*
	n	%	n	%	
Gender					
Male	132	47.8	260	47.5	0.94
Female	144	52.2	287	52.5	
Age (years)					
[20-40[	74	26.8	152	27.8	0.88
[40-55[	116	42.0	220	40.2	
[55-73[	86	31.2	175	32.0	
BMI (kg/m²)					
<25	142	51.5	305	55.8	0.48
[25-30]	97	35.1	179	32.7	
>30	37	13.4	63	11.5	

*: p-values derived from an Pearson's chi-squared test

Supplementary table 2: Adherence of PNNS 4 recommendation of patients with Lynch syndrome according to individual characteristics, AAS-Lynch study 2017-2022.

	Sex		Age (years)			BMI (kg/m ²)			Smoking status			Situation of precariousness		History cancer			History colorectal adenoma	
	Women vs Men	p*	[40-55[vs [20-40[	[55-73[vs [20-40[	p*	[25-30] vs <25	>30 vs <25	p*	Former smoker vs Non-smoker	Smoker vs Non-smoker	p*	Yes vs No	p*	CRC vs No	Extra-colic vs No	p*	Yes vs No	p*
adherence vs non adherence	OR [IC]		OR [IC]	OR [IC]		OR [IC]	OR [IC]		OR [IC]	OR [IC]		OR [IC]		OR [IC]	OR [IC]		OR [IC]	
Fruit and vegetable	2.59 [1.46-4.49]	0.01	2.09 [1.07-4.07]	4.15 [1.99-8.65]	<0.001	0.98 [0.55-1.75]	1.37 [0.60-3.16]	0.72	0.74 [0.41-1.33]	1.01 [0.46-2.25]	0.56	0.64 [0.30-1.39]	0.26	1.56 [0.80-3.05]	1.33 [0.65-2073]	0.38	1.42 [0.83-2.45]	0.20
Legume	1.5 [0.86-2.63]	0.15	0.69 [0.35-1.35]	0.64 [0.31-1.31]	0.44	1.07 [0.6-1.92]	1.09 [0.48-2.47]	0.96	1.26 [0.71-2.23]	0.7 [0.31-1.58]	0.39	0.7 [0.31-1.54]	0.38	0.67 [0.34-1.32]	0.42 [0.2-0.89]	0.06	1.68 [0.97-2.9]	0.06
Nuts	2.96 [1.24-7.07]	0.01	1.41 [0.47-4.17]	1.83 [0.6-5.58]	0.56	1.47 [0.63-3.43]	0.94 [0.28-3.1]	0.62	1.12 [0.5-2.5]	0.35 [0.07-1.77]	0.29	0.41 [0.09-1.88]	0.25	0.96 [0.34-2.66]	1.07 [0.4-2.79]	0.98	0.93 [0.42-2.05]	0.86
Red meat	0.95 [0.54-1.70]	0.87	0.98 [0.49-1.96]	0.81 [0.39-1.71]	0.82	0.87 [0.48-1.59]	0.42 [0.18-0.98]	0.13	0.86 [0.47-1.57]	0.88 [0.38-2.02]	0.88	0.49 [0.22-1.06]	0.07	0.91 [0.45-1.85]	0.65 [0.32-1.33]	0.49	1.19 [0.68-2.10]	0.54
Processed meat	0.91 [0.49-1.69]	0.78	1.79 [0.78-4.11]	2.5 [1.07-5.83]	0.10	1.01 [0.53-1.89]	0.39 [0.12-1.25]	0.27	0.97 [0.5-1.9]	1.11 [0.45-2.71]	0.96	0.74 [0.28-1.96]	0.55	1.41 [0.67-2.94]	1.06 [0.48-2.35]	0.65	0.85 [0.46-1.57]	0.61
Fish and seafood	0.8 [0.43-1.48]	0.49	0.82 [0.38-1.73]	0.96 [0.43-2.12]	0.85	1.27 [0.67-2.38]	0.94 [0.36-2.43]	0.71	1.03 [0.53-1.98]	1.33 [0.57-3.07]	0.79	0.96 [0.4-2.28]	0.94	1.27 [0.61-2.65]	1.14 [0.53-2.44]	0.80	1.7 [0.92-3.16]	0.09
Oily fish	0.79 [0.47-1.32]	0.38	0.95 [0.5-1.77]	0.87 [0.44-1.71]	0.92	0.71 [0.41-1.23]	0.81 [0.37-1.75]	0.48	1.5 [0.87-2.58]	1.36 [0.65-2.85]	0.31	0.5 [0.23-1.07]	0.08	0.87 [0.46-1.65]	0.99 [0.52-1.89]	0.91	1.28 [0.77-2.13]	0.34
Dairy product	1.09 [0.6-2]	0.77	0.7 [0.33-1.48]	0.77 [0.35-1.69]	0.65	1.38 [0.73-2.62]	1.5 [0.6-3.76]	0.50	2.05 [1.08-3.9]	1.47 [0.6-3.6]	0.09	0.65 [0.26-1.61]	0.36	3.9 [1.92-7.93]	1.54 [0.72-3.32]	0.001	0.88 [0.48-1.61]	0.69
Sweet Products ^a	1.31 [0.63-2.71]	0.46	1.47 [0.63-3.38]	1.74 [0.69-4.38]	0.46	0.96 [0.45-2.02]	1.4 [0.41-4.7]	0.84	1.69 [0.73-3.87]	0.83 [0.32-2.12]	0.35	2.91 [0.81-10.43]	0.10	1.31 [0.51-3.31]	1.43 [0.56-3.65]	0.68	1.77 [0.86-3.66]	0.12

Rich in ALA or olive oil (>50%)	0.74 [0.4-1.35]	0.33	0.65 [0.3-1.39]	0.94 [0.41-2.13]	0.43	1.02 [0.54-1.93]	1.19 [0.49-2.87]	0.92	2.07 [1.05-4.07]	0.87 [0.38-1.95]	0.07	0.32 [0.15-0.7]	0.004	2.01 [0.87-4.59]	0.92 [0.45-1.91]	0.22	0.64 [0.35-1.17]	0.15
Sweet beverage	0.72 [0.37-1.4]	0.34	1.56 [0.73-3.33]	2.2 [0.92-5.24]	0.20	0.74 [0.37-1.48]	0.44 [0.17-1.09]	0.20	1.32 [0.64-2.71]	0.54 [0.22-1.28]	0.17	1.47 [0.58-3.73]	0.41	0.64 [0.29-1.42]	1.02 [0.44-2.35]	0.52	1.03 [0.53-1.98]	0.93
Alcohol drink	3.02 [1.37-6.68]	0.006	1.02 [0.43-2.43]	0.80 [0.30-2.13]	0.86	1.39 [0.63-3.05]	1.39 [0.42-4.58]	0.67	0.44 [0.19-1.00]	0.33 [0.12-0.88]	0.04	1.15 [0.42-3.18]	0.78	0.64 [0.27-1.49]	1.89 [0.66-5.44]	0.20	1.41 [0.68-2.92]	0.36
Salt	2.44 [1.04-5.73]	0.04	0.51 [0.17-1.5]	0.77 [0.26-2.23]	0.44	0.74 [0.31-1.75]	0.57 [0.14-2.31]	0.65	0.32 [0.12-0.83]	0.92 [0.29-2.89]	0.07	0.49 [0.12-1.98]	0.32	0.81 [0.27-2.39]	0.79 [0.27-2.29]	0.88	1.71 [0.74-3.95]	0.20

Abbreviation: BMI: Body Mass Index.

*: Logistic regression model adjusted for sex, age, BMI, smoking status, situation of precariousness, history of cancer and history of colorectal adenomas.

a: Sweet Products: sugar, honey, jam, spread, chocolate, candy, dessert cream, ice cream, cake and biscuit.

Supplementary table 3: Adherence of EFSA dietary reference values of patients with Lynch syndrome according to individual characteristics, AAS-Lynch study 2017-2022.

	Sex		Age (years)			BMI (kg/m ²)			Smoking status			Situation of precariousness		History cancer			History colorectal adenoma	
	Women vs Men	p*	[40-55[vs [20-40[	[55-73[vs [20-40[	p*	[25-30] vs <25	>30 vs <25	p*	Former smoker vs Non-smoker	Smoker vs Non-smoker	p*	Yes vs No	p*	CR vs No	Extra-colic vs No	p*	Yes vs No	p*
adherence vs non adherence	OR [IC]		OR [IC]	OR [IC]		OR [IC]	OR [IC]		OR [IC]	OR [IC]		OR [IC]		OR [IC]	OR [IC]		OR [IC]	
Carbohydrate	0.67	0.19	1.38	1.91	0.25	0.98	0.97	1.00	0.5	1.27	0.06	0.85	0.72	0.72	0.640	0.43	0.75	0.33

	[0.37-1.2]		[0.66-2.9]	[0.88-4.1]		[0.53-1.81]	[0.4-2.35]		[0.25-0.97]	[0.58-2.76]		[0.37-1.97]		[0.34-1.53]	[0.29-1.37]		[0.42-1.33]	
Fibre	1.71	0.13	1.62	2.22	0.23	0.82	0.76	0.81	0.8	0.33	0.15	0.6	0.33	0.69	0.54	0.37	1.47	0.26
	[0.84-3.44]		[0.69-3.79]	[0.88-5.58]		[0.4-1.69]	[0.27-2.13]		[0.4-1.6]	[0.1-1.01]		[0.22-1.66]		[0.3-1.6]	[0.21-1.36]		[0.75-2.87]	
Lipid	0.47	0.02	1.03	1.26	0.80	1.16	1.15	0.87	0.54	0.67	0.18	1.5	0.31	0.52	0.53	0.13	1.16	0.61
	[0.25-0.86]		[0.49-2.16]	[0.58-2.73]		[0.62-2.18]	[0.48-2.77]		[0.28-1.05]	[0.29-1.57]		[0.68-3.32]		[0.23-1.14]	[0.24-1.18]		[0.64-2.1]	
Linolenic acid	2.82	0.001	0.83	1.66	0.13	1.07	0.41	0.23	0.94	0.56	0.49	0.25	0.03	1.75	1.37	0.28	1.37	0.31
	[1.5-5.29]		[0.38-1.82]	[0.76-3.64]		[0.57-2.02]	[0.14-1.22]		[0.5-1.78]	[0.21-1.46]		[0.07-0.89]		[0.85-3.64]	[0.64-2.93]		[0.74-2.52]	
Linoleic acid	0.47	0.01	0.99	1.14	0.91	0.64	0.49	0.16	1.19	2.43	0.07	0.83	0.65	0.76	0.99	0.73	1.04	0.88
	[0.27-0.82]		[0.5-1.95]	[0.55-2.34]		[0.36-1.15]	[0.2-1.22]		[0.65-2.16]	[1.14-5.15]		[0.37-1.83]		[0.37-1.53]	[0.5-1.98]		[0.6-1.8]	
EPA + DHA	1.22	0.46	1.03	2.24	0.03	0.69	0.72	0.40	0.95	1.00	0.99	0.67	0.30	1.3	0.58	0.13	0.73	0.25
	[0.71-2.08]		[0.54-1.96]	[1.1-4.58]		[0.39-1.21]	[0.33-1.57]		[0.54-1.68]	[0.46-2.18]		[0.32-1.41]		[0.67-2.53]	[0.3-1.12]		[0.42-1.24]	
	[0.76-2.92]		[0.62-3.22]	[0.48-2.75]		[0.28-1.23]	[0.57-3.64]		[0.08-0.45]	[0.43-2.46]		[1.14-6.09]		[0.23-1.40]	[0.24-1.41]		[0.28-1.06]	
Sodium	2.31	0.21	0.94 [	1.22	0.93	0.56	0.89	0.70	1.54	2.84	0.50	0.36	0.32	1.25	2.12	0.61	0.61	0.46
	[0.62-8.66]		0.19-4.68]	[0.25-5.95]		[0.14-2.15]	[0.12-6.25]		[0.38-6.19]	[0.47-16.99]		[0.04-2.71]		[0.24-6.5]	[0.48-9.33]		[0.16-2.23]	
Calcium	1.95	0.02	0.86 [	1.55	0.19	1.15	1.11	0.88	1.09	0.48	0.13	0.75	0.47	0.96	1.24	0.81	1.07	0.79
	[1.11-3.41]		0.44-1.69]	[0.75-3.2]		[0.64-2.07]	[0.47-2.59]		[0.61-1.97]	[0.21-1.05]		[0.35-1.61]		[0.49-1.89]	[0.6-2.55]		[0.62-1.85]	
Iron	0.72	0.39	3.51 [	5.75	0.003	0.98	0.76	0.91	1.09	0.96	0.97	0.61	0.42	0.92	0.74	0.83	0.88	0.74
	[0.34-1.52]		1.33-9.27]	[2.07-15.98]		[0.45-2.09]	[0.22-2.57]		[0.5-2.37]	[0.33-2.78]		[0.19-2]		[0.37-2.28]	[0.29-1.91]		[0.42-1.84]	
Potassium	1.91	0.08	1.49 [	1.77	0.45	1.03	0.69	0.78	1.36	1.05	0.67	0.49	0.20	0.71	0.6	0.47	1.5	0.24
	[0.93-3.94]		0.64-3.46]	[0.71-4.4]		[0.51-2.08]	[0.23-2.08]		[0.68-2.74]	[0.38-2.89]		[0.17-1.43]		[0.3-1.63]	[0.24-1.5]		[0.76-2.95]	
Magnesium	6.71	<0.001	1.54	4.19	0.01	1.26	1.67	0.64	1.12	0.73	0.78	0.52	0.23	1.41	0.63	0.41	0.84	0.64
	[2.89-15.58]		[0.64-3.73]	[1.57-10.98]		[0.59-2.67]	[0.52-5.37]		[0.53-2.35]	[0.25-2.16]		[0.18-1.50]		[0.58-3.39]	[0.24-1.67]		[0.42-1.71]	
Iodine	1.89	0.05	0.93	1.98	0.10	1.15	0.54	0.37	1.04	0.88	0.94	0.71	0.47	1.08	0.63	0.59	0.66	0.19
	[0.99-3.63]		[0.43-2.01]	[0.88-4.48]		[0.60-2.20]	[0.19-1.49]		[0.54-1.99]	[0.35-2.23]		[0.28-1.81]		[0.50-2.33]	[0.30-1.53]		[0.35-1.23]	
Vitamin A	0.53	0.06	1.45	0.3	0.001	2.11	0.75	0.05	1.25	1.67	0.51	1.01	0.97	0.61	0.47	0.19	0.53	0.06
	[0.28-1.01]		[0.68-3.11]	[0.12-0.73]		[1.07-4.16]	[0.26-2.14]		[0.62-2.54]	[0.67-4.14]		[0.41-2.53]		[0.27-1.36]	[0.19-1.16]		[0.27-1.02]	
Vitamin E	7.6	<0.001	1.28	1.99	0.25	1.03	1.1	0.98	0.67	0.24	0.02	0.51	0.15	1.04	0.64	0.56	1.17	0.61
	[3.65-5.84]		[0.59-2.8]	[0.85-4.65]		[0.53-2.02]	[0.4-3]		[0.34-1.29]	[0.09-0.67]		[0.2-1.27]		[0.47-2.28]	[0.27-1.49]		[0.62-2.19]	
Vitamin C	3.8	<0.001	0.67	1.57	0.04	0.86	1.54	0.47	0.77	0.61	0.43	0.65	0.29	1.08	0.67	0.49	1.03	0.91
	[2.11-6.84]		[0.34-1.33]	[0.74-3.29]		[0.48-1.57]	[0.64-3.72]		[0.42-1.4]	[0.27-1.37]		[0.3-1.43]		[0.54-2.17]	[0.32-1.38]		[0.59-1.8]	
Vitamin B2	1.91	0.09	1.4	2.13	0.28	0.85	0.52	0.56	0.84	0.38	0.21	1.84	0.30	0.8	0.64	0.63	0.7	0.34

	[0.91-4]		[0.56-3.48]	[0.82-5.48]		[0.39-1.81]	[0.16-1.7]		[0.39-1.81]	[0.13-1.1]		[0.57-5.88]		[0.32-2.01]	[0.25-1.63]		[0.33-1.44]	
Vitamin B5	1.98	0.07	1.51	1.65	0.56	0.68	0.6	0.53	0.7	1.03	0.65	1.57	0.45	0.78	0.43	0.22	0.61	0.20
	[0.93-4.21]		[0.59-3.85]	[0.63-4.28]		[0.31-1.47]	[0.18-1.94]		[0.32-1.54]	[0.36-2.92]		[0.49-5.02]		[0.31-1.96]	[0.17-1.11]		[0.29-1.29]	
Vitamin B6	3.39	0.003	1.11	0.95	0.94	1.42	1.44	0.64	0.45	0.5	0.13	2.49	0.13	1.56	0.86	0.57	0.72	0.40
	[1.5-7.65]		[0.43-2.81]	[0.36-2.51]		[0.64-3.13]	[0.43-4.76]		[0.2-1.02]	[0.17-1.45]		[0.75-8.26]		[0.6-4.05]	[0.32-2.25]		[0.34-1.53]	
Vitamin B9	2	0.03	1.69	3.33	0.01	0.72	1.47	0.35	0.69	0.76	0.52	0.57	0.24	1.43	0.87 [0.38-	0.56	1.11	0.72
	[1.06-3.79]		[0.79-3.62]	[1.46-7.6]		[0.37-1.38]	[0.55-3.91]		[0.35-1.32]	[0.31-1.88]		[0.23-1.44]		[0.67-3.04]	1.97]		[0.6-2.05]	
Vitamin B12	0.97	0.95	2.71	1.72	0.17	0.97	0.37	0.25	1.33	1.6	0.65	1.83	0.34	0.7	0.42	0.20	0.59	0.22
	[0.44-2.11]		[0.96-7.64]	[0.62-4.74]		[0.41-2.26]	[0.11-1.24]		[0.56-3.14]	[0.51-5.05]		[0.52-6.4]		[0.25-1.92]	[0.16-1.09]		[0.26-1.36]	

Abbreviation: BMI: Body Mass Index.

*: Model adjusted for sex, age, BMI, smoking status, situation of precariousness, history of cancer and history of colorectal adenomas. idem

Table 4: Food group intakes of patients with Lynch syndrome according to individual characteristics, AAS-Lynch study 2017-2022.

Food Group Intakes	Sex			Age (years)				BMI (kg/m ²)				Smoking status				Situation of precariousness			History cancer				History colorectal adenoma		
	Men	Women	p*	[20-40[	[40-55[	[55-73[	p*	<25	[25-30]	>30	p*	Non-smoker	Former smoker	Smoker	p*	No	Yes	p*	No	CRC	Extra-colic cancer	p*	No	Yes	p*
Fruit (g/day)	154.3	208.6	0.01	134.1	186.8	223.4	0.005	192.0	191.6	160.6	0.57	193.3	190.6	160.3	0.53	198.8	164.0	0.23	184.0	191.5	168.7	0.76	174.4	188.4	0.49
Vegetable (g/day)	211.7	275.7	0.003	209.4	232.3	289.2	0.01	252.4	233.2	245.4	0.69	257.4	256.1	217.6	0.41	263.0	224.4	0.19	239.7	246.1	245.2	0.96	217.7	269.6	0.01
Legume (g/day)	11.1	15.3	0.09	13.4	13.4	12.7	0.97	13.3	14.5	11.7	0.76	13.1	14.5	12.0	0.77	14.3	12.1	0.53	12.4	11.6	15.5	0.55	11.5	14.9	0.18

Nuts (g/day)	4.5	7.4	0.02	5.5	6.4	6.0	0.84	5.5	6.7	5.6	0.67	6.1	6.5	5.2	0.82	7.2	4.6	0.15	5.1	5.5	7.2	0.41	5.8	6.1	0.76
Bread, pasta, rice (g/day)	20.4	16.3	<0.001	24.4	17.4	13.2	0.46	18.2	17.3	19.6	0.06	16.0	16.5	22.6	0.92	14.5	22.2	0.71	20.7	15.9	18.5	0.03	16.4	20.3	0.87
Potato (g/day)	29.2	22.1	0.01	22.7	24.3	29.9	0.09	23.6	22.2	31.1	0.10	23.8	27.1	26.0	0.50	28.5	22.8	0.13	24.9	27.1	24.9	0.80	25.3	26.0	0.78
Red meat (g/day)	80.8	71.9	0.16	76.7	78.8	73.4	0.76	71.7	78.9	78.3	0.52	78.2	76.3	74.4	0.91	69.3	83.3	0.11	76.7	74.6	77.6	0.95	75.5	77.1	0.80
Processed Meat (g/day)	49.5	47.9	0.66	50.2	54.0	41.9	0.02	46.7	44.6	54.8	0.22	49.0	55.0	42.2	0.07	41.3	56.1	0.01	48.7	46.2	51.2	0.69	48.4	49.0	0.87
Fish (g/day)	37.5	42.3	0.48	32.5	37.6	49.6	0.13	38.7	36.5	44.4	0.76	39.2	44.9	35.6	0.61	46.0	33.8	0.20	44.0	40.0	35.8	0.61	41.2	38.6	0.71
Dairy product (g/day)	285.1	306.1	0.43	275.6	294.0	317.4	0.47	306.8	294.0	286.1	0.83	318.8	302.2	265.9	0.38	282.0	309.3	0.46	322.1	247.4	317.5	0.07	288.8	302.5	0.60
Cake and biscuit (g/day)	56.6	56.4	0.98	59.7	59.5	50.4	0.48	59.3	55.8	54.5	0.85	52.2	45.6	71.7	0.06	64.4	48.6	0.11	53.7	62.1	53.7	0.62	59.9	53.1	0.33
Sugar and confectionery (g/day) ^a	50.4	42.9	0.23	42.6	49.8	47.5	0.64	49.2	53.9	36.9	0.22	48.6	51.4	40.0	0.49	52.4	40.9	0.18	49.8	52.4	37.7	0.23	54.9	38.4	0.01
Fried product (g/day)	249.8	205.9	0.04	238.3	221.7	223.4	<0.001	217.6	212.1	253.8	0.75	229.0	224.4	230.1	0.07	224.8	230.8	0.01	244.1	232.8	206.6	0.14	228.7	226.9	0.05
Sweetened soft (g/day)	173.7	217.1	0.15	241.5	185.0	159.7	0.11	161.5	208.3	216.3	0.24	193.8	144.9	247.4	0.07	212.1	178.7	0.43	199.8	188.4	198.0	0.95	219.7	171.1	0.11
Alcohol drinks (g/day)	120.0	69.4	<0.001	92.5	85.7	105.8	0.41	89.7	92.4	102.0	0.82	78.1	108.6	97.5	0.08	102.3	87.1	0.41	87.3	111.4	85.5	0.29	90.5	98.9	0.51
Coffee (ml/day)	192.9	166.8	0.17	166.5	176.2	196.9	0.44	193.4	171.4	174.8	0.51	144.5	195.9	199.2	0.02	206.4	153.3	0.05	185.7	190.4	163.4	0.58	158.8	200.9	0.03

Tea (ml/day)	59.4	237.4	0.002	75.4	196.7	172.9	0.19	228.4	181.6	35.1	0.06	170.0	158.4	116.6	0.80	205.6	91.0	0.14	118.3	179.2	147.4	0.66	189.7	106.9	0.13
MEDI-LITE score	8.92	9.35	0.16	8.82	8.89	9.69	0.04	9.29	9.11	9.01	0.75	9.02	9.01	9.37	0.70	9.13	9.47	8.81	0.37	8.99	9.28	0.34	9.51	8.76	0.08
Dietary Patterns																									
“Western” diet ^b	0.25	0.07	0.02	0.37	0.10	-0.001	<0.001	0.05	0.15	0.27	0.10	0.08	0.15	0.24	0.30	0.06	0.25	0.06	0.16	0.22	0.10	0.57	0.20	0.12	0.24
“Healthy” diet ^c	-0.36	-0.01	0.001	-0.39	-0.21	0.06	0.01	-0.12	-0.20	-0.23	0.71	-0.15	-0.11	-0.29	0.57	0.00	-0.36	0.02	-0.20	-0.11	-0.24	0.74	-0.24	-0.13	0.33

Abbreviation: BMI: Body Mass Index.

*: Adjusted means and p-values derived from an ANCOVA model adjusted for sex, age, BMI, smoking status, situation of precariousness, history of cancer and history of colorectal adenomas.

a: Sugar and confectionery: sugar, honey, jam, spread, chocolate, candy, dessert cream and ice cream.

b: “Western” pattern: loading coefficient $\geq |0.20|$ with red meat, poultry, processed meat, egg, potato, starch without potato, fried products, fats and sauces, cake and biscuits, sugar and confectionery, sweetened and alcohol drinks.

c: “Healthy” patter

n: loading coefficient $\geq |0.20|$ with vegetables, fruits, legumes, egg, fish and seafood, dairy products, breakfast cereals, nuts, fats and sauces and hot drinks.