COVID -19 and Nutrition - Recommendations for Prevention and Immune optimization

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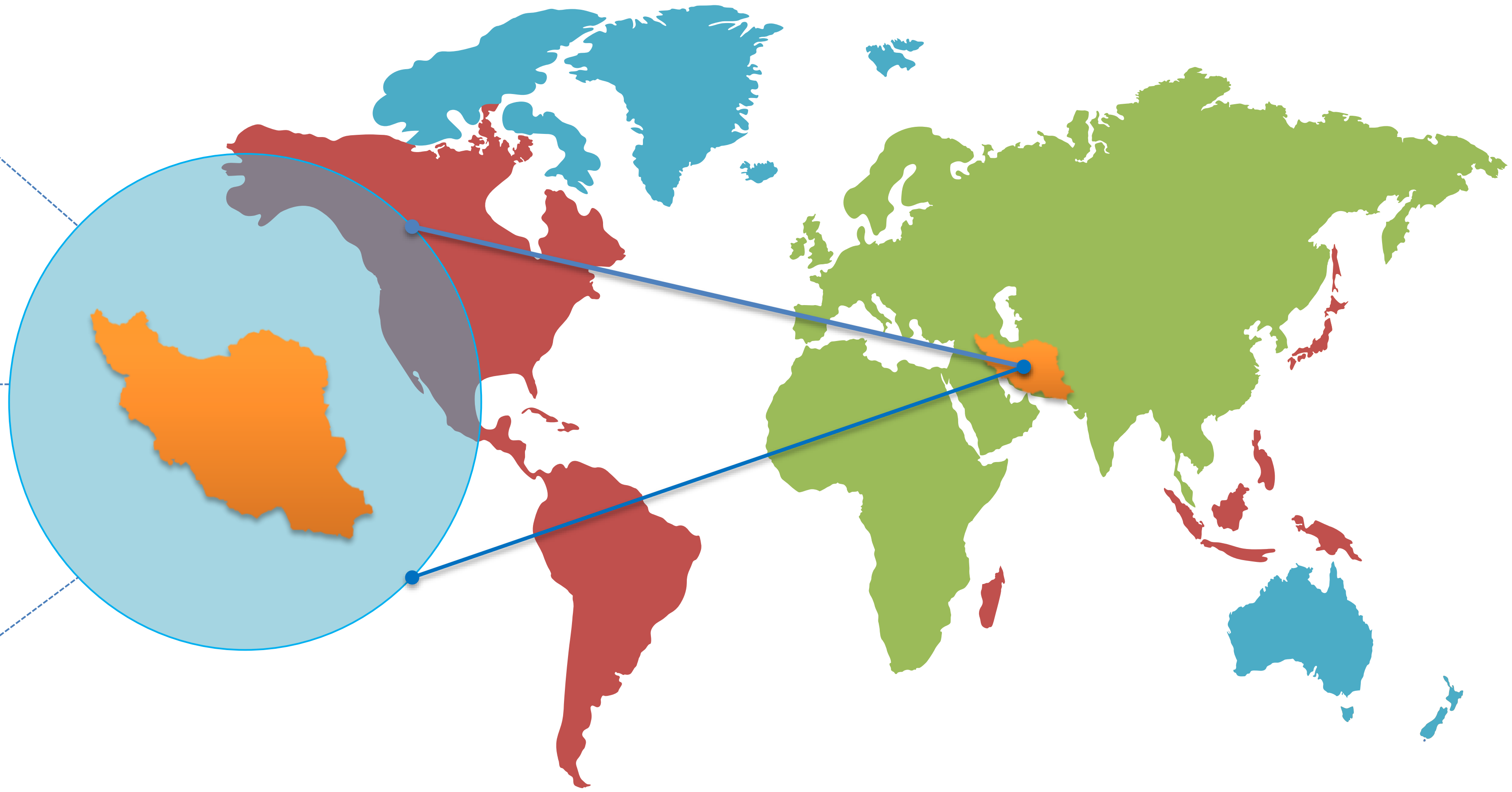
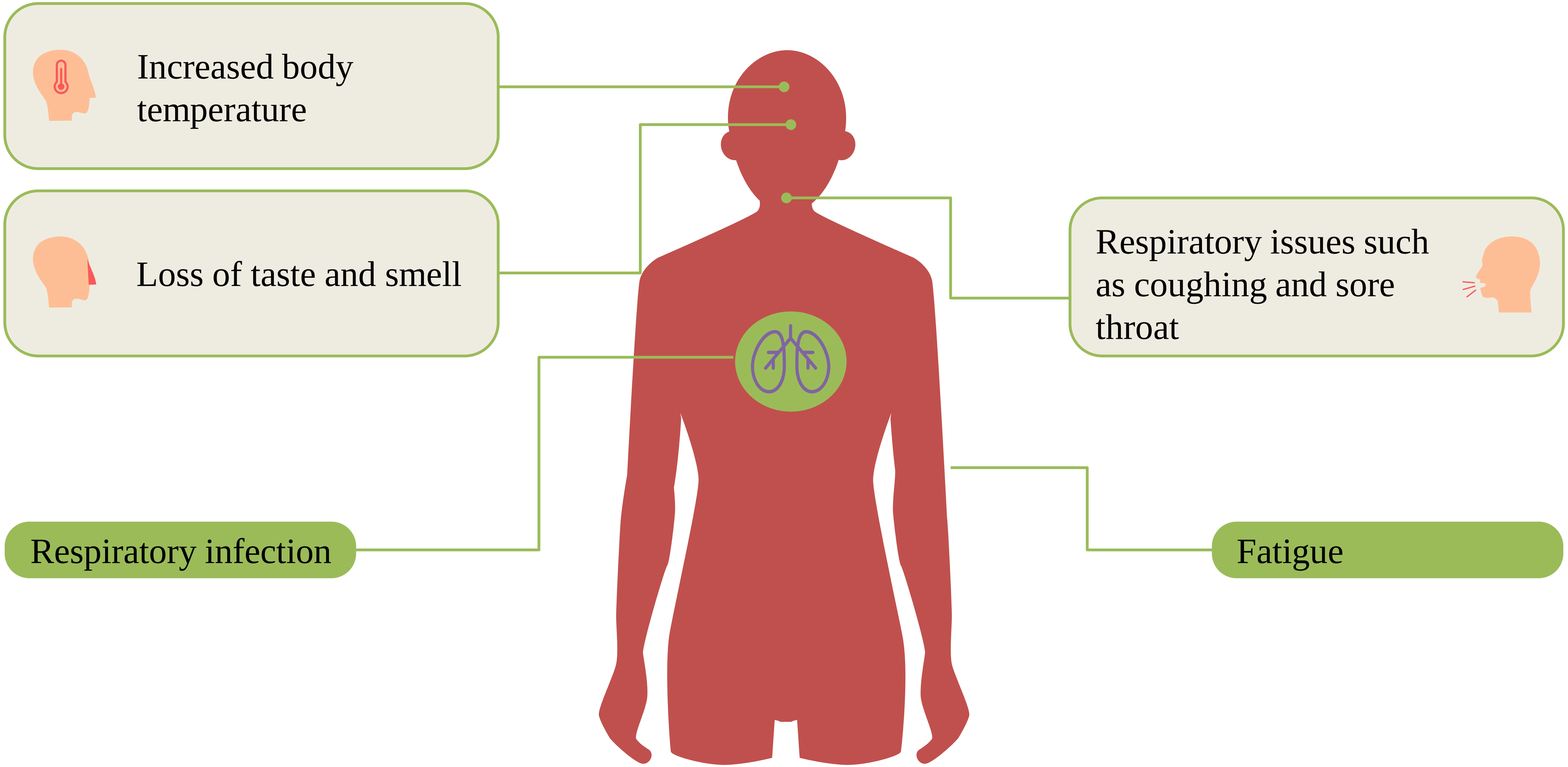
6258181
confirmed cases of
COVID-19

132251
Deaths

129022276
vaccine
doses have been
administered



Covid syptoms



The role of nutrition in strengthening immune system against newly emerging viral diseases: case of SARS-CoV-2

- To preserve organism defense mechanisms, adequate nutritional status should be maintained with appropriate intakes of calories, vitamins, minerals and water that should be continuously provided by a healthy diet.
- The nutritional status of each COVID-19-infected patient should be assessed prior undertaking treatments. Nutritional support should be the basis of management of any infected individual.
- However, prevention measures remain the first priority and strategy to develop throughout proper hygiene, healthy diet and staying home.

Nutrition and Immune Support

- Adequate nutrition supports the optimal functioning of the immune system

- Enhancement of immune system function and natural defenses most effectively allows the body to fight off infection

- Nutrition and lifestyle are key factors in preexisting conditions such as metabolic syndrome

Lifestyle and Immune System

- Moderate levels of exercise enhance immune function, but intensive training can impair function

- Psychological stress increases susceptibility to infections

- Increased social support is protective against upper respiratory infections

- Components of the typical Western diet can have an adverse effect on immunity, as well as affecting obesity, diabetes, and other conditions increasing vulnerability
  - Sugar
  - Saturated fat
  - Red meat
  - Salt

Lifestyle factors and Inflammation

- Obesity promotes low-grade inflammation
- Gut microflora can affect inflammation
- Regular exercise decreases inflammation
- Diet can play a role in chronic inflammation

Diet and inflammation

Diet: Decreased inflammation

- Healthy diet: whole grains,
- Fruits and vegetables, fish
- Vitamin C
- Vitamin E
- Carotenoids
- Zinc
- Omega three fatty acids
- Magnesium
- Mediterranean diet

Diet: Increased inflammation

- Saturated and trans fat
- High glucose/high fat meals

Micro-nutrients with the strongest evidence for immune support are:

- Vitamin C
- Vitamin D
- Zinc

Other nutrients that may help include:

- Vitamin A
- Vitamin E
- Selenium
- Omega 3's
- B vitamins
- Plant Phytonutrients

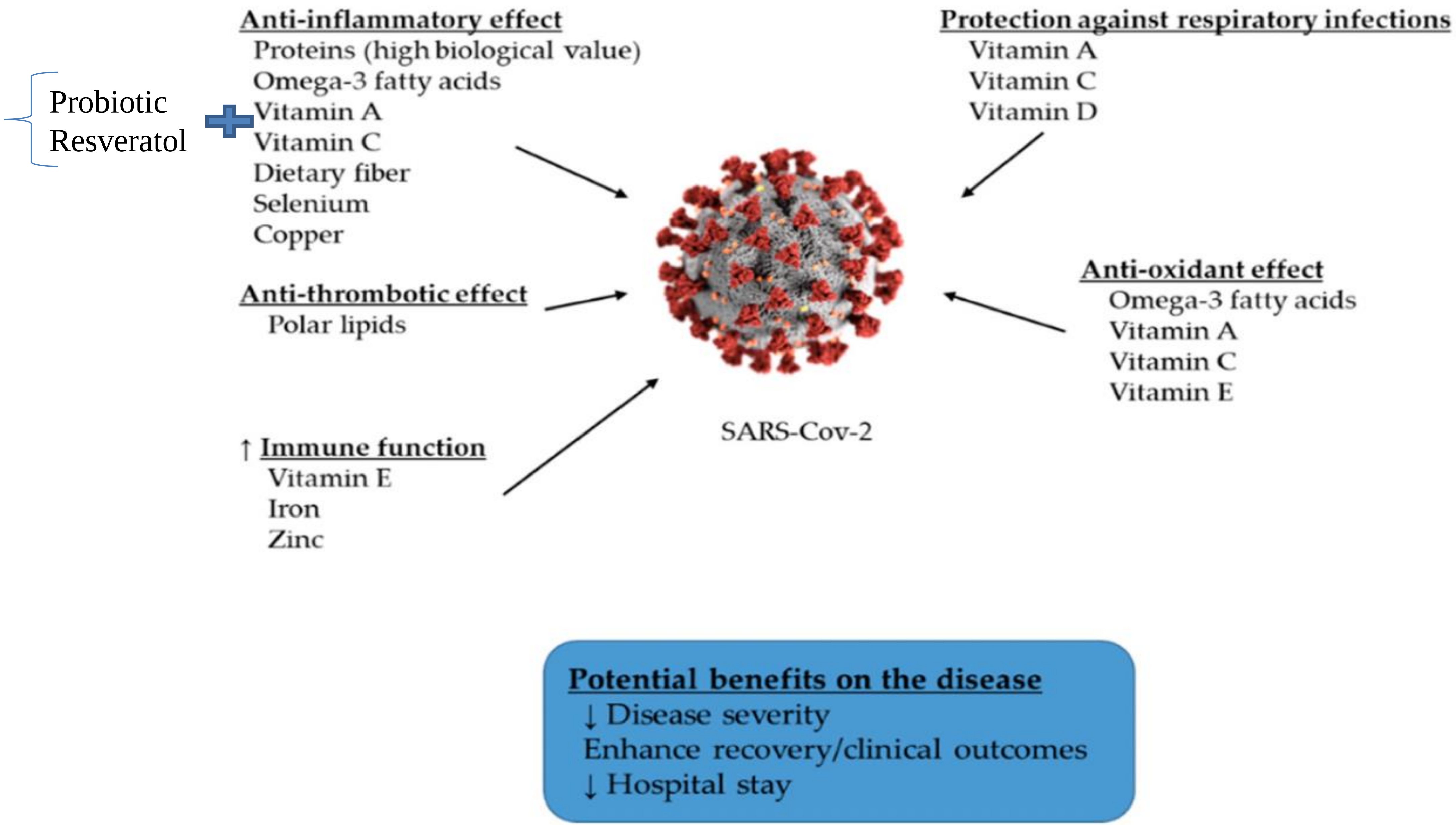


Figure 2. Effects of several nutrients on aspects of COVID-19 infection. ↑: increase, ↓: decrease.

The role of dietary proteins

- Protein deficiency has been linked to a reduction in immune system function because it reduces the quantity of functional immunoglobulins and the amount of gut-associated lymphoid tissue (GALT)

Protein High Biological Value

Protein quality rankings.

Protein Type	Protein Efficiency Ratio	Biological Value	Net Protein Utilization	Protein Digestibility Corrected Amino Acid Score
Beef	2.9	80	73	0.92
Black Beans	0		0	0.75
Casein	2.5	77	76	1.00
Egg	3.9	100	94	1.00
Milk	2.5	91	82	1.00
Peanuts	1.8			0.52
Soy protein	2.2	74	61	1.00
Wheat gluten	0.8	64	67	0.25
Whey protein	3.2	104	92	1.00

Adapted from: U.S Dairy Export Council, Reference Manual for U.S. Whey Products 2nd Edition, 1999 and Sarwar, 1997.

Protein Type	Protein Digestibility (%)	Biological Value (%)
		Animal source
Red meat [1]		80
Casein [1,3,6]	99	77
Whey [1]		104
Milk [1,4,6]	96	91
Egg [1,4,6]	98	100
		Plant source
Black bean [1,6,8]	70	
Cooked black bean [7,8]	83	
Soy flour [5,8]	80	
Soy protein isolate [1,6]	98	74
Green lentil [3,4]	84	
Yellow split pea [4,6]	88	
Cooked pea [7]	89	
Pea protein concentrate [7]	99	
Chickpea [3,4]	89	
Peanuts [1]		
Roasted peanuts [7]	98	
Peanut butter [3,4]	98	
Whole grains [2]		
Wheat [3,5,6]	91	56–68
Wheat gluten [1]		64
White bread [4,6]	93	
White rice [4,6]	93	
Cooked rice [7]	87	

Omega-3 fatty acid

- Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are omega-3 fatty acids that can inactivate enveloped viruses by changing the ideal host lipid environment for viral reproduction.

Omega-3 fatty acid

- EPA and DHA, on the other hand, block cyclooxygenase enzymes (COX) and, as a result, may aid in the suppression of prostaglandin (pro-inflammatory) production.

Omega-3 fatty acid

Species	Total fat	EPA	DHA	EPA + DHA[a]
			g/100g	
Salmon, Atlantic, farmed	12.4	0.690	1.457	2.147
Anchovy, European, canned in oil[b]	9.7	0.763	1.292	2.055
Herring, Atlantic, cooked	11.6	0.909	1.105	2.014
Salmon, Atlantic, wild, cooked	8.1	0.411	1.429	1.840
Salmon, Chinook, cooked	13.4	1.010	0.727	1.737
Tuna, Bluefin, fresh, cooked	6.3	0.363	1.141	1.504
Sardine, Pacific, canned in tomb,[c]	10.5	0.532	0.865	1.397
Salmon, Sockeye, cooked	11.0	0.530	0.700	1.230
Mackerel, Atlantic, cooked	17.8	0.504	0.699	1.203
Halibut, Greenland, cooked	17.7	0.674	0.504	1.178
Trout, Rainbow, farmed, cooked	7.2	0.334	0.820	1.154
Trout, Rainbow, wild, cooked	5.8	0.468	0.520	0.988
Swordfish, cooked	5.1	0.138	0.681	0.819
Halibut, Atlantic and Pacific, cooked	2.9	0.091	0.374	0.465
Shrimp, mixed species, cooked	1.1	0.171	0.144	0.315
Tuna, light, canned in water	0.8	0.047	0.223	0.270
Grouper, mixed species, cooked	1.3	0.035	0.213	0.248
Haddock, cooked	0.9	0.076	0.162	0.238
Catfish, Channel, wild, cooked	2.9	0.100	0.137	0.237
Catfish, Channel, farmed, cooked	8.0	0.049	0.128	0.177
Cod, Atlantic, cooked	0.9	0.004	0.154	0.158

[a] Ranked from highest to lowest EPA + DHA value

a Drained solids

b Tomato sauce

Source: Lee *et al.*, 2008; USDA, 2007

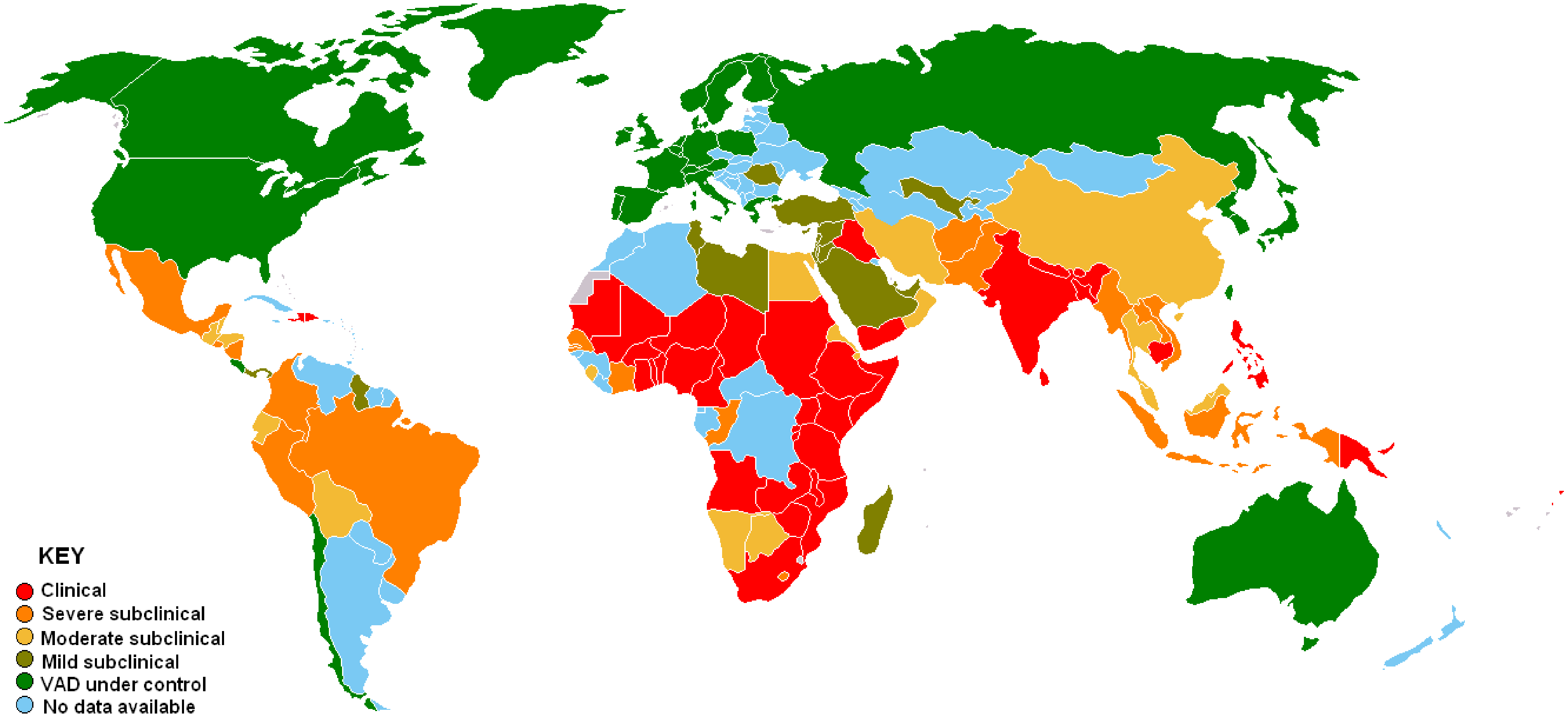
Vitamin A

- Vitamin A is important in the immune system functions because it aids in the production of a healthy mucus layer and enhances antigen non-specific immune responses.

Vitamin A

- Indeed, vitamin A insufficiency has been linked to histological changes in the pulmonary epithelium and parenchyma, resulting in reduced respiratory performance.

Global distribution of vitamin A deficiency



Vitamin A

Food Stuff	RAEs µg	% of RDA
Liver (beef, pork, chicken, turkey, fish), cod liver oil	6500 µg	722 %
Carrot	835 µg	93 %
Broccoli leaf	800 µg	89 %
Sweet potato	709 µg	79 %
Butter	684 µg	76%
Kale	681 µg	76 %
Spinach	469 µg	52 %
Pumpkin	400 µg	41 %
Collard greens	333 µg	37 %
Cheddar cheese	265 µg	29 %
Cantaloupe melon	169 µg	19 %
Egg	140 µg	16 %
Apricot	96 µg	11 %
Papaya	55 µg	6 %
Mango	38 µg	4 %
Pea	38 µg	4 %
Broccoli	31 µg	3 %
Milk	28 µg	3%

These data are adapted from USDA database (http://www.nal.usda.gov/fnic/foodcomp/search/).
Abbreviations: RAEs, is retinol activity equivalences, % of RDA (**Recommended Daily Allowance**), is the average percentage of adult male per 100 grams of the food stuff.

Vitamin C

- In healthy young adult humans, a vitamin C-deficient diet reduced mononuclear cell vitamin C content by 50% and reduced T lymphocyte-mediated immune responses to recall antigens.
- Vitamin C deficiency makes people more prone to serious respiratory infections like pneumonia.

Vitamin C

Food	Measurement		Vitamin C (mg)	% RDA	
	Serving	Weight (g)		Men	Women
Rose hips (raw)	½ cup	100	426	473.3%	568%
Gold kiwifruit (raw)	1 cup, sliced	186	196	217.8%	261.3%
Sweet red pepper (raw)	1 cup, chopped	149	190.4	211.6%	253.9%
Broccoli (boiled)	1 cup, chopped	156	101.2	112.4%	134.9%
Orange (raw)	1 cup, sections	180	95.8	106.4%	127.7%
Strawberries (raw)	1 cup, halves	152	89.4	99.3%	119.2%
Orange juice	1 cup	249	83.7	93%	111.6%
Grapefruit (raw)	1 cup, sections	230	79.1	87.9%	105.5%
Cherry tomatoes (raw)	1 cup	149	20.4	22.7%	27.2%
Spinach (boiled)	1 cup	180	17.6	19.6%	23.5%
Potato (baked)	1 potato w/ skin	148	14.2	15.8%	18.9%

(Modified from U.S. Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference Release 27 [86], & National Nutrient Database for Standard Reference [87])

Dietary Fiber and Carbs

- Consumption of carbohydrates with higher glycemic indices (highly processed carbs) can lead to mitochondrial overload and subsequent free radical production.

Dietary Fiber and Carbs

- Consumption of these carbs has been linked to an increase in the levels of inflammatory cytokines in the blood.

- Fiber consumption of 25–35 grams per day may aid in the reduction of both systemic and intestinal inflammation.

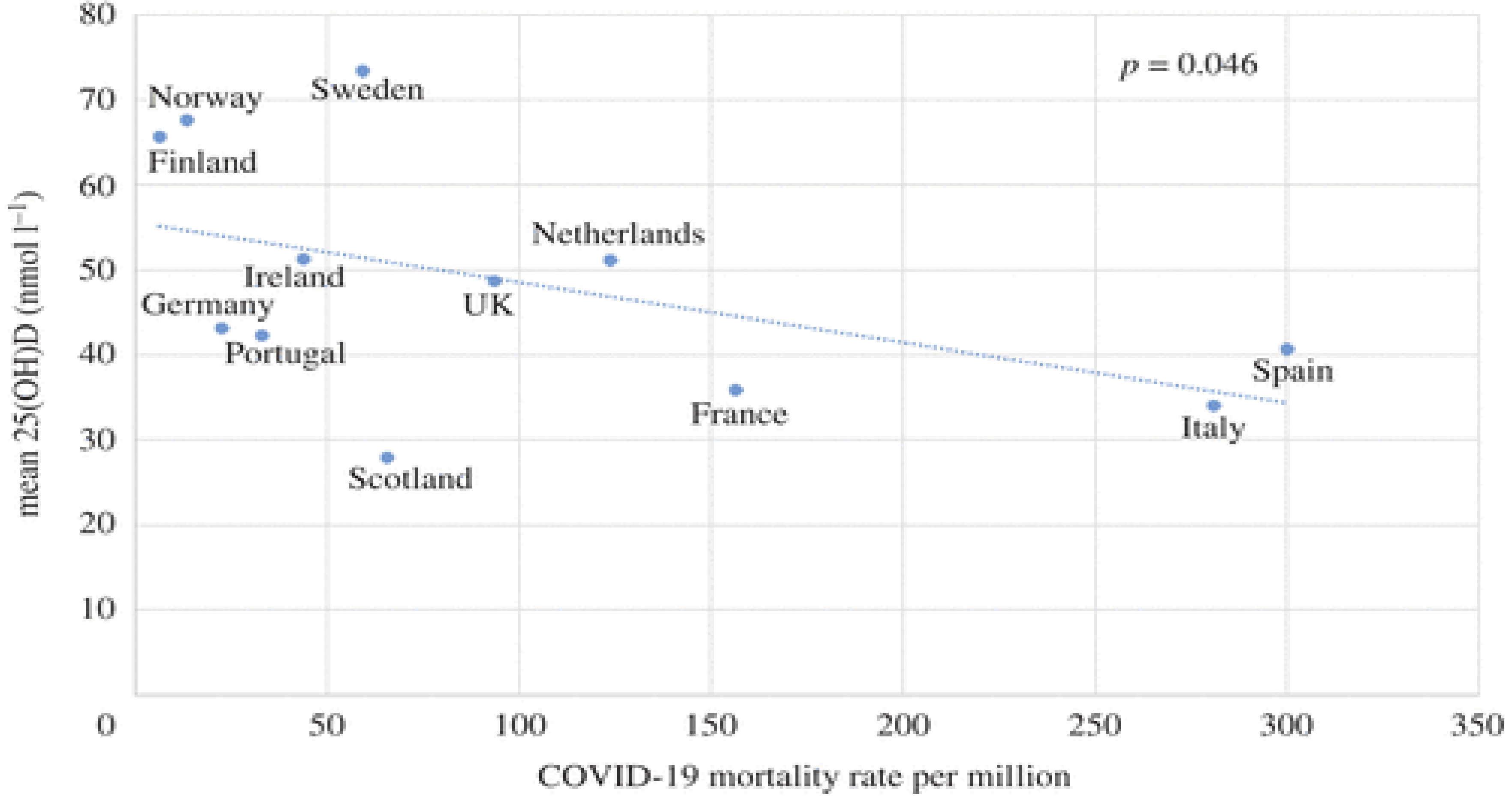
Dietary Fiber and Carbs

- Consumption of **fiber-rich meals** has been linked to reduced levels of inflammatory cytokines (CRP, TNF-alpha, and IL-6), as well as higher levels of short-chain fatty acids (SCFAs)

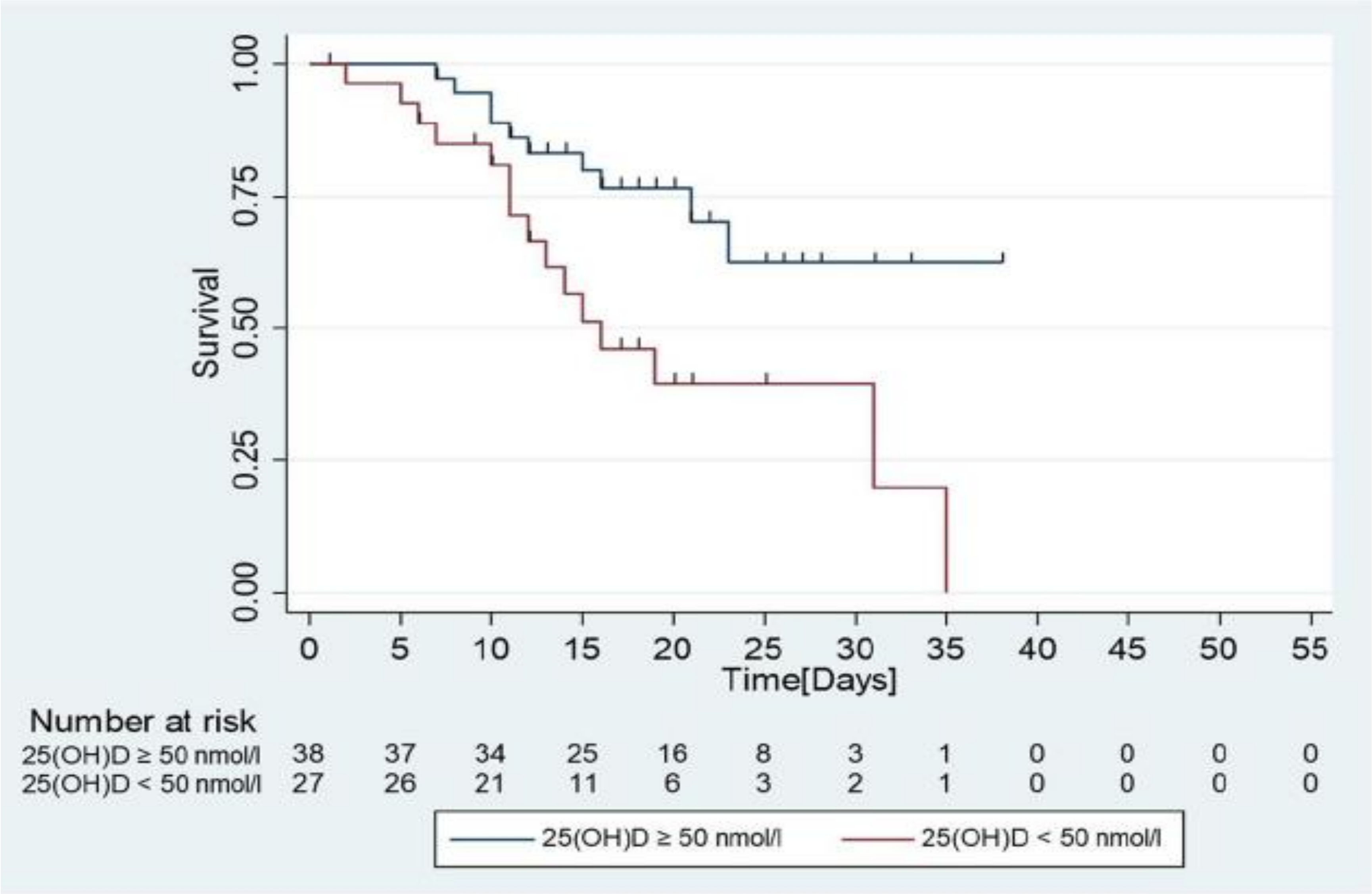
Short Chain Fatty Acids

- SCFAs (acetate, propionate, and butyrate) have a direct anti-inflammatory action by suppressing proinflammatory molecule production and lowering nuclear factor kappa B expression (NF-kB)

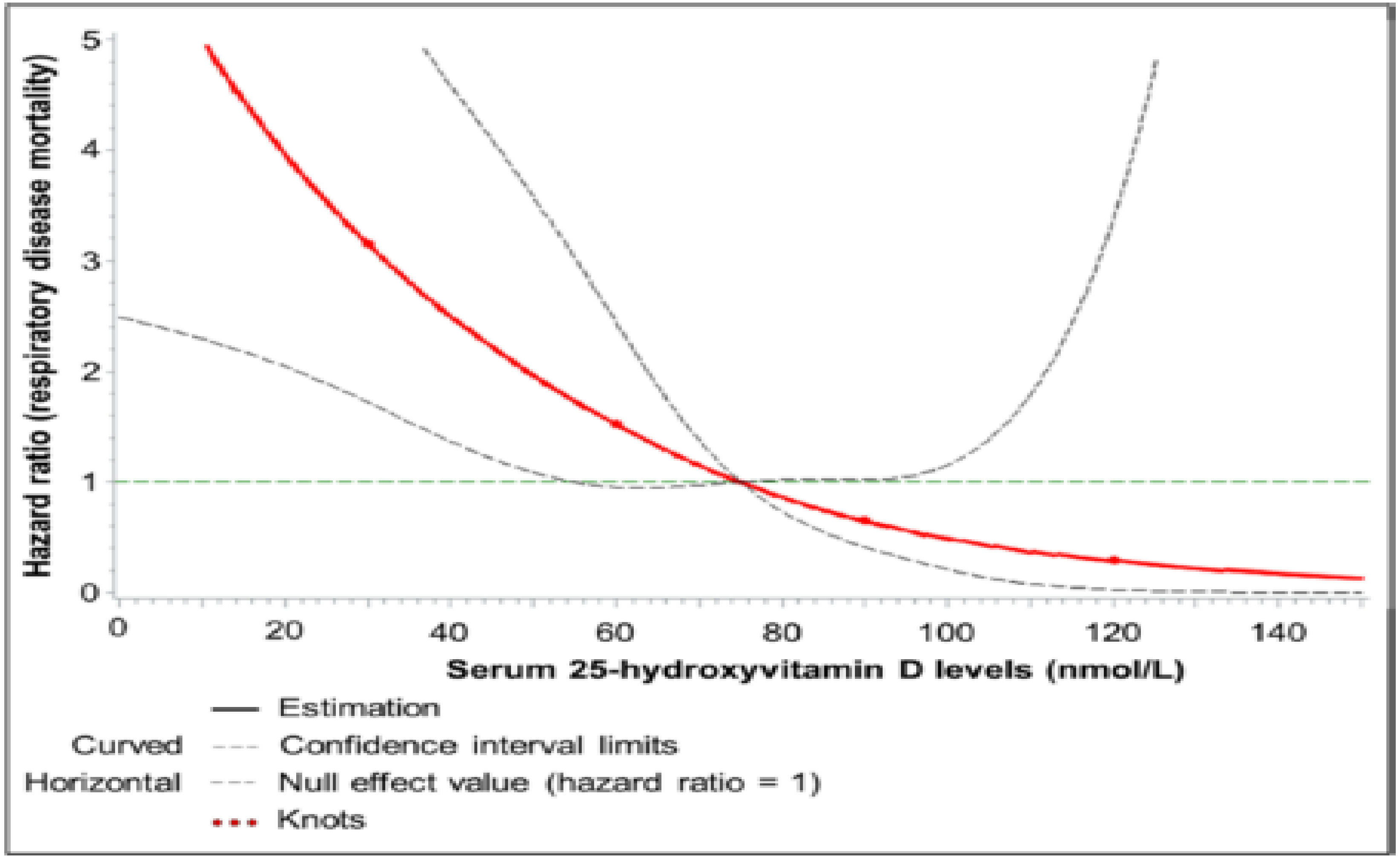
Ecologic study on vitamin D levels and COVID-19 mortality



Kaplan–Meier survival analysis according to 25(OH)D levels in men with COVID-19



Dose–response relationship between 25(OH)D levels and respiratory disease mortality.



Probiotics

Probiotics can exert protection against viral infections at three different levels:

(a) providing a stronger innate immune response in the gut,

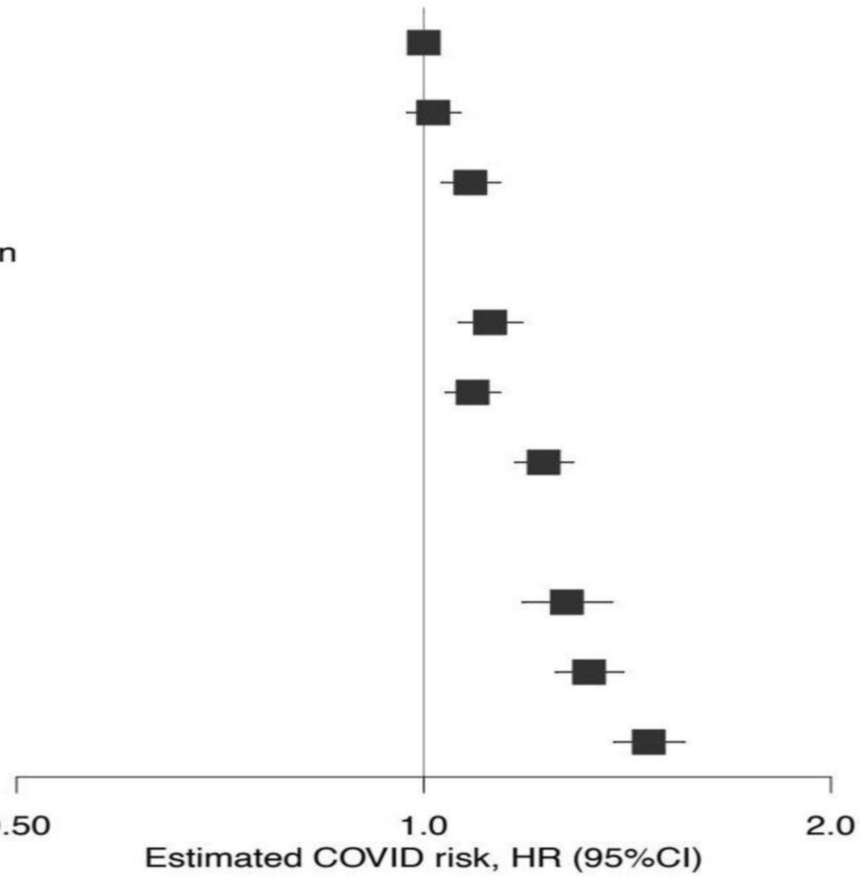
(b) decreasing the gut permeability

(c) regulating the acquired immune response

RESVERATROL

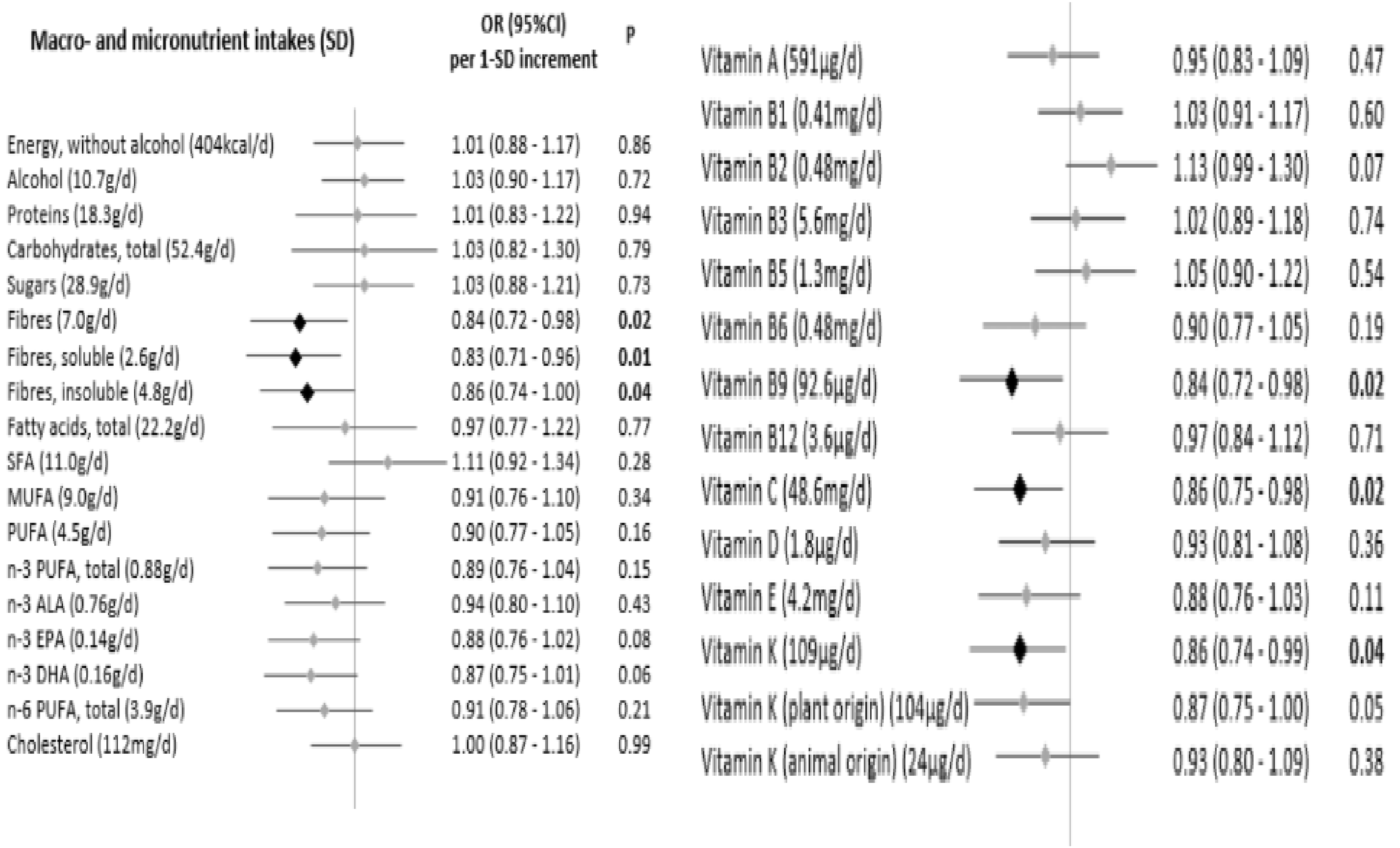
Peanut butter	0.02-0.98 μg/g
Peanuts	0.01-0.07 μg/g
Green peanuts	0.19-0.72 μg/g
Polygonum cuspidatum	296-377 μg/g
Green grapes	0.02-0.32 μg/g
Black grapes	0.95-1.88 μg/g
Raisins	0.0005-0.003 μg/g
Grape juice-black	Traces-0.09 μg/g
Grape juice-green	Traces-0.01 μg/g

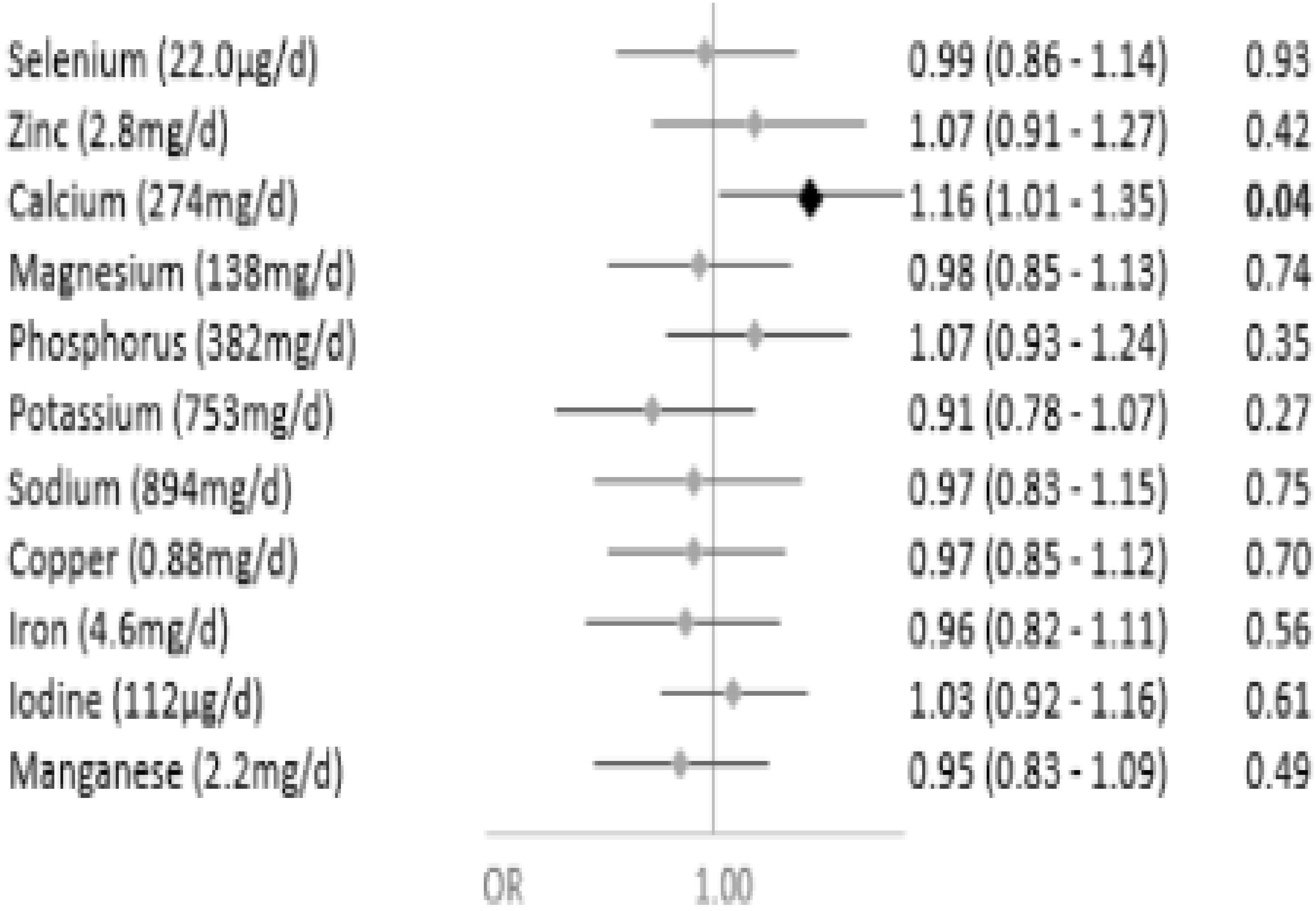
Risk of COVID-19 according to diet quality and socioeconomic deprivation.



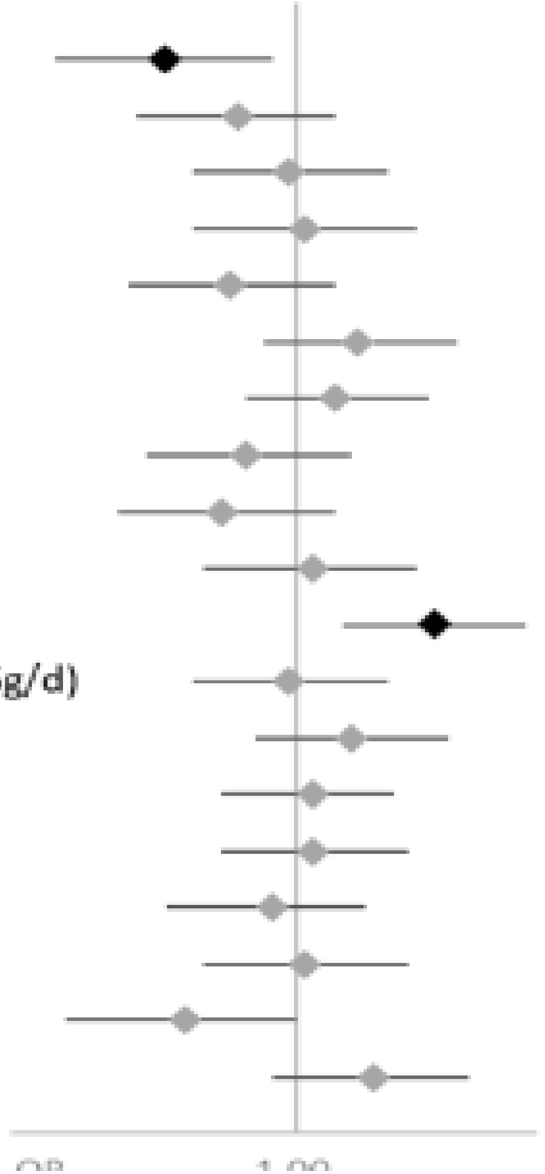
Subgroup	Total No. of participants	COVID−19 cases Person−Month	Adjusted HR [95% CI]	P Value
Low Socioeconomic Deprivation				
High hPDI	66,714	2,916 / 446,623	1.00[Reference]	
Intermediate hPDI	133,557	6,139 / 892,602	1.02[0.97−1.06]	0.481
Low hPDI	60,759	3,499 / 398,407	1.08[1.03−1.14]	0.002
Intermediate Socioeconomic Deprivation				
High hPDI	56,354	2,905 / 372,964	1.12[1.06−1.18]	<0.001
Intermediate hPDI	110,890	5,660 / 731,895	1.09[1.04−1.15]	<0.001
Low hPDI	56,143	3,810 / 359,896	1.23[1.17−1.29]	<0.001
High Socioeconomic Deprivation				
High hPDI	15,053	9,79 / 97,708	1.28[1.18−1.37]	<0.001
Intermediate hPDI	31,590	2,152 / 202,751	1.33[1.25−1.40]	<0.001
Low hPDI	20,752	1,787 / 126,752	1.47[1.38−1.56]	<0.001

Jordi Merino et al. Gut 2021;70:2096-2104


Macro- and micronutrient intakes (SD)
OR (95%CI) per 1-SD increment
P
Energy, without alcohol (404kcal/d) 1.01 (0.88 - 1.17) 0.86
Alcohol (10.7g/d) 1.03 (0.90 - 1.17) 0.72
Proteins (18.3g/d) 1.01 (0.83 - 1.22) 0.94
Carbohydrates, total (52.4g/d) 1.03 (0.82 - 1.30) 0.79
Sugars (28.9g/d) 1.03 (0.88 - 1.21) 0.73
Fibres (7.0g/d) 0.84 (0.72 - 0.98) 0.02
Fibres, soluble (2.6g/d) 0.83 (0.71 - 0.96) 0.01
Fibres, insoluble (4.8g/d) 0.86 (0.74 - 1.00) 0.04
Fatty acids, total (22.2g/d) 0.97 (0.77 - 1.22) 0.77
SFA (11.0g/d) 1.11 (0.92 - 1.34) 0.28
MUFA (9.0g/d) 0.91 (0.76 - 1.10) 0.34
PUFA (4.5g/d) 0.90 (0.77 - 1.05) 0.16
n-3 PUFA, total (0.88g/d) 0.89 (0.76 - 1.04) 0.15
n-3 ALA (0.76g/d) 0.94 (0.80 - 1.10) 0.43
n-3 EPA (0.14g/d) 0.88 (0.76 - 1.02) 0.08
n-3 DHA (0.16g/d) 0.87 (0.75 - 1.01) 0.06
n-6 PUFA, total (3.9g/d) 0.91 (0.78 - 1.06) 0.21
Cholesterol (112mg/d) 1.00 (0.87 - 1.16) 0.99
Vitamin A (591µg/d) 0.95 (0.83 - 1.09) 0.47
Vitamin B1 (0.41mg/d) 1.03 (0.91 - 1.17) 0.60
Vitamin B2 (0.48mg/d) 1.13 (0.99 - 1.30) 0.07
Vitamin B3 (5.6mg/d) 1.02 (0.89 - 1.18) 0.74
Vitamin B5 (1.3mg/d) 1.05 (0.90 - 1.22) 0.54
Vitamin B6 (0.48mg/d) 0.90 (0.77 - 1.05) 0.19
Vitamin B9 (92.6µg/d) 0.84 (0.72 - 0.98) 0.02
Vitamin B12 (3.6µg/d) 0.97 (0.84 - 1.12) 0.71
Vitamin C (48.6mg/d) 0.86 (0.75 - 0.98) 0.02
Vitamin D (1.8µg/d) 0.93 (0.81 - 1.08) 0.36
Vitamin E (4.2mg/d) 0.88 (0.76 - 1.03) 0.11
Vitamin K (109µg/d) 0.86 (0.74 - 0.99) 0.04
Vitamin K (plant origin) (104µg/d) 0.87 (0.75 - 1.00) 0.05
Vitamin K (animal origin) (24µg/d) 0.93 (0.80 - 1.09) 0.38


Selenium (22.0μg/d)
0.99 (0.86 - 1.14)
0.93
Zinc (2.8mg/d)
1.07 (0.91 - 1.27)
0.42
Calcium (274mg/d)
1.16 (1.01 - 1.35)
0.04
Magnesium (138mg/d)
0.98 (0.85 - 1.13)
0.74
Phosphorus (382mg/d)
1.07 (0.93 - 1.24)
0.35
Potassium (753mg/d)
0.91 (0.78 - 1.07)
0.27
Sodium (894mg/d)
0.97 (0.83 - 1.15)
0.75
Copper (0.88mg/d)
0.97 (0.85 - 1.12)
0.70
Iron (4.6mg/d)
0.96 (0.82 - 1.11)
0.56
Iodine (112μg/d)
1.03 (0.92 - 1.16)
0.61
Manganese (2.2mg/d)
0.95 (0.83 - 1.09)
0.49
OR
1.00

Food groups (SD)	OR (95%CI) per 1-SD increment	P
Fruit and vegetables (187.1g/d)	0.85 (0.74 - 0.97)	0.02
Legumes (23.5g/d)	0.93 (0.82 - 1.05)	0.25
Nuts, unsalted (10.7g/d)	0.99 (0.88 - 1.12)	0.89
Starchy foods* (85.8g/d)	1.01 (0.88 - 1.16)	0.87
Red meat (26.0g/d)	0.92 (0.81 - 1.05)	0.21
Processed meat (22.3g/d)	1.08 (0.96 - 1.22)	0.20
Poultry (19.0g/d)	1.05 (0.94 - 1.18)	0.36
Eggs (15.7g/d)	0.94 (0.83 - 1.07)	0.34
Fish (23.8g/d)	0.91 (0.80 - 1.05)	0.19
Seafood (12.0g/d)	1.02 (0.89 - 1.16)	0.81
Dairy products (132.6g/d)	1.19 (1.06 - 1.33)	0.002
Cakes, biscuits and pastries (37.5g/d)	0.99 (0.88 - 1.12)	0.89
Sweet products** (50.2g/d)	1.07 (0.95 - 1.21)	0.28
Breakfast cereals (14.3g/d)	1.02 (0.91 - 1.13)	0.78
Unsweetened drinks (525.7g/d)	1.02 (0.91 - 1.15)	0.71
Sugary drinks (85.5g/d)	0.97 (0.85 - 1.09)	0.58
Alcoholic drinks (129.7g/d)	1.01 (0.89 - 1.15)	0.87
Added fat, plant origin (8.3g/d)	0.87 (0.75 - 1.00)	0.048
Added fat, animal origin (7.5g/d)	1.10 (0.97 - 1.24)	0.13



Original research

Risk factors for developing COVID-19: a population-based longitudinal study (COVIDENCE UK)

Hayley Holt,[1] Mohammad Talaei,[1] Matthew Greenig,[1] Dominik Zenner,[1] Jane Symons,[2] Clare Relton,[1] Katherine S Young,[3] Molly R Davies,[3] Katherine N Thompson,[3] Jed Ashman,[1] Sultan Saeed Rajpoot,[1] Ahmed Ali Kayyale,[1] Sarah El Rifai,[1] Philippa J Lloyd,[1] David Jolliffe,[1] Olivia Timmis,[1] Sarah Finer,[1] Stamatina Iliodromiti,[1] Alec Miners,[4] Nicholas S Hopkinson,[5] Bodrul Alam,[6] Graham Lloyd-Jones,[7] Thomas Dietrich,[8] Iain Chapple,[8] Paul E Pfeffer,[1] David McCoy,[1] Gwyneth Davies,[9] Ronan A Lyons,[9] Christopher Griffiths,[1] Frank Kee,[10] Aziz Sheikh,[11] Gerome Breen,[3] Seif O Shaheen,[1] Adrian R Martineau[1]

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/thoraxjnl-2021-217487).

For numbered affiliations see end of article.

ABSTRACT

Background Risk factors for severe COVID-19 include older age, male sex, obesity, black or Asian ethnicity and underlying medical conditions. Whether these factors also influence susceptibility to developing COVID-19 is uncertain.

Methods We undertook a prospective, population-based cohort study (COVIDENCE UK) from 1 May 2020

Key messages

What is the key question?

► How do demographic, socioeconomic, lifestyle, dietary, pharmacological and comorbidity factors relate to the risk of developing COVID-19 in the general adult population of the UK?

nutrients

Article

Mediterranean Diet and SARS-COV-2 Infection: Is There Any Association? A Proof-of-Concept Study

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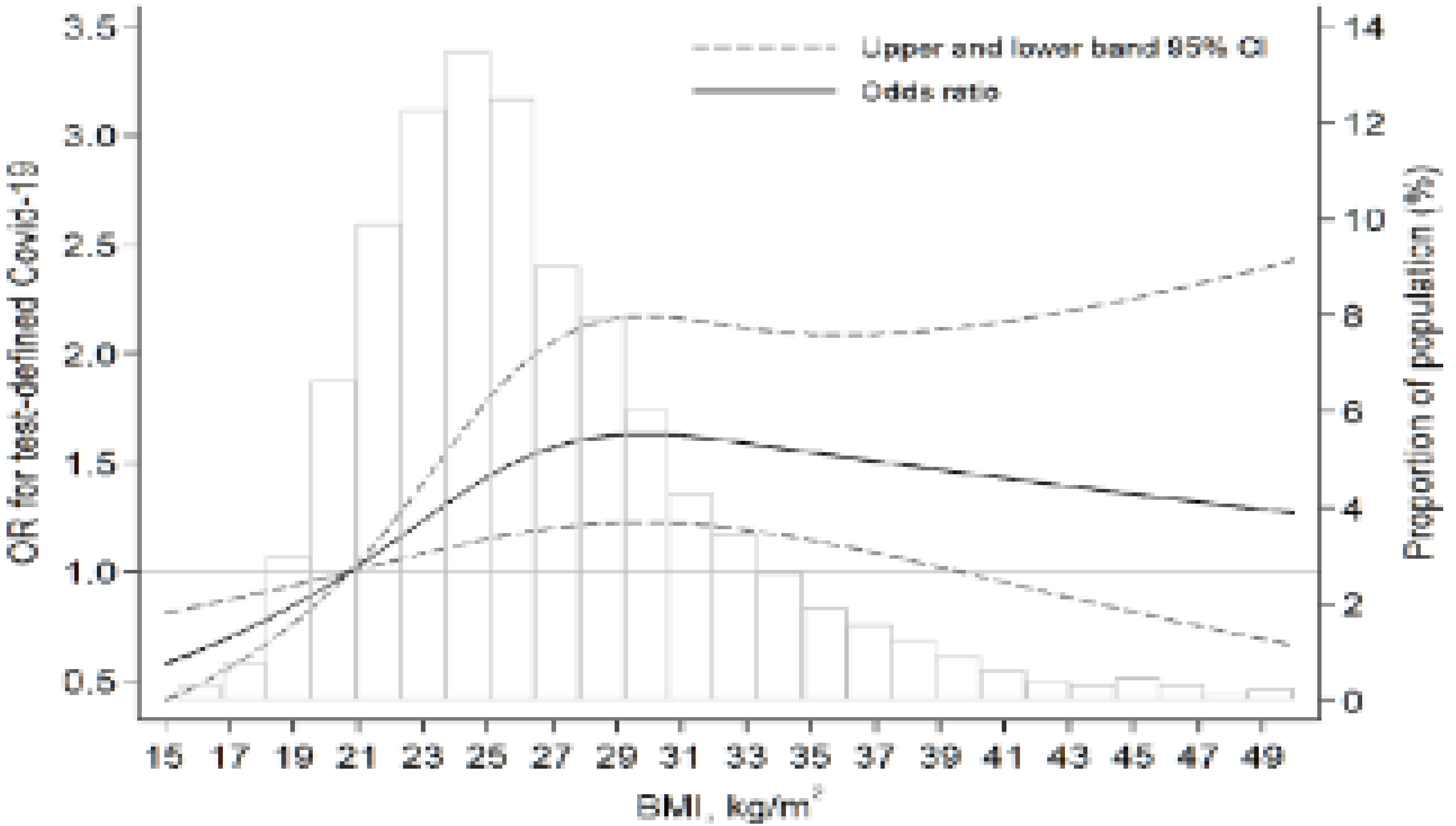
Table 4. Association between SARS-COV-2 infection and adherence to the MeD by logistic regression analyses.

SARS-COV-2 Infection (*n* = 900)—Model 1			
	OR	**95% CI**	***p***
Total carbohydrate (%kcal)	0.99	0.96–1.03	0.71
Saturated fats (%kcal)	1.00	0.96–1.04	0.99
Protein (%kcal)	1.02	0.97–1.09	0.42
Fiber (g/day)	0.98	0.95–1.02	0.31
MeD score	0.88	0.81–0.97	0.010
SARS-COV-2 Infection (*n* = 900)—Model 2			
	OR	**95% CI**	***p***
Total carbohydrate (%kcal)	1.01	0.97–1.05	0.70
Saturated fats (%kcal)	1.00	0.96–1.05	0.77
Protein (%kcal)	1.05	0.98–1.11	0.15
Fiber (g/day)	0.98	0.94–1.02	0.29
Fruit	0.85	0.64–1.13	0.27
Vegetables	0.86	0.63–1.19	0.37
Cereals	0.64	0.45–0.90	0.010
Olive oil	0.95	0.65–1.40	0.81
Severity of the SARS-COV-2 Infection (*n* = 148) §			
	OR	**95% CI**	***p***
Age (years)	1.05	1.01–1.09	0.006
Saturated fats (%kcal)	1.09	1.01–1.17	0.029

A (BMI)



Upper and lower band 95% CI
Odds ratio
OR for test-defined Covid-19
Proportion of population (%)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
14
12
10
8
6
4
2
0
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
BMI, kg/m²

World Health Organisation: Nutrition Advice during the COVID-19 outbreak

- Eat fresh and unprocessed foods every day
- Drink enough water every day
- Eat moderate amounts of fat and oil
- Eat less salt and sugar

THANK YOU