PNNS-GS2 - Development and validation of a diet quality score reflecting the 2017 French dietary guidelines

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**Abbreviations**:

PNNS: *Programme National Nutrition Santé*, Health and Nutrition French Program

PNNS-GS: PNNS - Guideline Score

sPNNS-GS2: simplified PNNS-GS2

HEI: Healthy Eating Index

HCSP: *Haut Conseil de la Santé Publique*, High Council of Public Health

ANSES: *Agence nationale de sécurité sanitaire de l’alimentation, de l’environnement et du travail*, French Agency for Food, Environmental and Occupational Health & Safety

BMI: body mass index

MUFA, PUFA & SFA: mono-unsaturated, poly-unsaturated & saturated fatty acids

N-3 ALA = alpha linolenic acid, N-6 ALA = alpha linoleic acid, DHA = docosahexaenoic acid, DPA= docosapentaenoic acid, EPA= eicosapentaenoic acid

# Supplemental Tables

Supplemental Table 1 – Score PNNS-GS: Components and Scoring

|  |  |  |  |
| --- | --- | --- | --- |
|  | Recommendation | Scoring criteria1 | Score |
| Fruits and vegetables  | At least 5 per day | [0 – 3.5[ | 0 |
| [3.5 – 5[ | 0.5 |
| [5 – 7.5[ | 1 |
| ≥ 7.5 | 2 |
| Bread, cereals, potatoes and legumes | At each meal according to appetite | [0 – 1[ | 0 |
| [1 – 3[ | 0.5 |
| [3 – 6[ | 1 |
| ≥ 6 | 0.5 |
| Whole grain food | Preferentially choose whole grains and whole grain breads | [0 – 1/3[ | 0 |
| [1/3 – 2/3[ | 0.5 |
| ≥ 2/3 | 1 |
| Milk and dairy products  | 3 per day(≥ 55 years: 3 to 4 per day) | [0 – 1[ | 0 |
| [1 – 2.5[ | 0.5 |
| [2.5 – 3.5] (≥ 55-year-old subjects: [2.5 – 4.5]) | 1 |
| > 3.5 (≥ 55-year-old subjects: > 4.5) | 0 |
| Meat and poultry, seafood and eggs  | 1 to 2 per day | 0 | 0 |
| ]0-1[ | 0.5 |
| [1 – 2] | 1 |
| > 2 | 0 |
| Seafood | At least twice a week | < 2 servings per week | 0 |
| ≥ 2 servings per week | 1 |
| Added fats 2 | Limit consumption | Lipids from added fats> 16%EI 3 per day | 0 |
| Lipids from added fats≤ 16%EI3 per day | 1 |
| Vegetable added fats | Favor fats of vegetable origin | No use of vegetable oil or ratio vegetable oil/total added fats ≤0.5 | 0 |
| No use of added fats or ratio vegetable oil/total added fats >0.5 | 1 |
| Sugary foods2 | Limit consumption | Added sugars from sugary foods ≥15%EI3 per day | -0.5 |
| Added sugars from sugary foods [10 – 15[%EI3 per day | 0 |
| Added sugars from sugary foods < 10%EI3 per day | 1 |
| BeveragesWater and soda2 | Drink water as desiredLimit sweetened beverages: no more than one glass per day | < 1 L of water and > 250 mL of soda per day | 0 |
| ≥ 1 L of water and > 250 mL of soda per day | 0.50 |
| < 1 L of water and ≤ 250 mL of soda per day | 0.75 |
| ≥ 1 L of water and ≤ 250 mL of soda per day | 1 |
| Alcohol | Women4 advised to drink ≤ 2 glasses of wine per day and ≤ 3 glasses per day for men. | Ethanol >20 g/d for women and >30 g for men | 0 |
| Ethanol ≤20 g/d for women and ≤30 g for men | 0.8 |
| Abstainers and irregular consumers (< once a week) | 1 |
| Salt2 | Limit consumption | > 12 g /d | -0.5 |
| ]10 – 12] g /d | 0 |
| ]8 – 10] g /d | 0.5 |
| ]6 – 8] g /d | 1 |
| ≤ 6 g /d | 1.5 |
| Physical activity | At least the equivalent of 30 min of brisk walking per day | [0 – 30[min /d | 0 |
| [30 – 60[min / d | 1 |
| ≥ 60 min /d | 1.5 |

1 Servings per day unless otherwise noted

2 Established according to the French RDA

3 EI: total energy intake without alcohol

4 Pregnant women are advised to abstain from all alcohol consumption during the entire duration of pregnancy

Supplemental Table 2 – Characteristics of included and excluded participants for both PNNS-GS2 and sPNNS-GS2.

|  |  | **PNNS-GS2** |  |  |  | **sPNNS-GS2**  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Excluded** | **Included** | **p a** |  | **Excluded** | **Included** | **p a** |
| **N** |  | 23417 | 80965  |  |  | 5928 | 98454 |  |
| **Age at inclusion (years) b** |  | 40.65 (14.43) | 44.38 (14.56) | \*\*\* |  | 39.21 (14.04) | 43.8 (14.61) | \*\*\* |
| **Body mass index (kg/m²) b** |  | 24.02 (4.81) | 23.81 (4.53) | \*\*\* |  | 24.14 (4.96) | 23.84 (4.57) | \*\*\* |
| **PNNS-GS b** |  | 8.47 (1.91) | 8.98 (1.86) | \*\*\* |  | 8.30 (1.62) | 8.91 (1.88) | \*\*\* |
| **mPNNS-GS b** |  | 7.55 (1.73) | 8.01 (1.65) | \*\*\* |  | 7.57 (1.77) | 7.94 (1.67) | \*\*\* |
| **Education c** |  |  |  | \*\*\* |  |  |  | \*\*\* |
| **Primary** |  | 1.54% | 1.01% |  |  | 2.08% | 1.08% |  |
| **Secondary** |  | 38.66% | 34.15% |  |  | 45.54% | 34.54% |  |
| **University** |  | 59.80% | 64.84% |  |  | 52.39% | 64.39% |  |
| **Occupational category c** |  |  |  | \*\*\* |  |  |  | \*\*\* |
| **Farmers and self-employed** |  | 2.41% | 1.91% |  |  | 2.42% | 2.00% |  |
| **Managerial staff** |  | 20.38% | 23.56% |  |  | 14.92% | 23.32% |  |
| **Employees** |  | 22.07% | 17.54% |  |  | 25.88% | 18.11% |  |
| **Students** |  | 12.16% | 7.33% |  |  | 13.06% | 8.14% |  |
| **Manual workers** |  | 1.91% | 1.12% |  |  | 3.14% | 1.19% |  |
| **Intermediates professions** |  | 15.73% | 17.40% |  |  | 16.27% | 17.07% |  |
| **Retired** |  | 12.17% | 19.48% |  |  | 10.74% | 18.27% |  |
| **Unemployed** |  | 13.17% | 11.66% |  |  | 13.58% | 11.90% |  |
| **Income c** |  |  |  | \*\*\* |  |  |  | \*\*\* |
| **<=1800 euros/uc** |  | 54.98% | 45.32% |  |   | 62.51% | 46.58% |  |
| **1800 - 2700 euros/uc** |  | 23.77% | 26.85% |  |   | 21.73% | 26.43% |  |
| **>2700 euros/uc** |  | 21.25% | 27.83% |  |   | 15.76% | 26.99% |  |
| **Physical activity c** |  |  |  | \*\*\* |  |  |  | \* |
| **[0-30[ minutes/day** |  | 28.95% | 26.68% |  |   | 34.21% | 27.08% |  |
| **[30-60[ minutes/day** |  | 23.69% | 24.43% |  |   | 26.97% | 24.29% |  |
| **>=60 minutes/day** |  | 47.36% | 48.89% |  |   | 38.82% | 48.63% |  |
| **Smoking c** |  |  |  | \*\*\* |  |  |  | \*\*\* |
| **Non smokers** |  | 48.43% | 50.18% |  |   | 49.36% | 49.81% |  |
| **Former smokers** |  | 30.97% | 34.33% |  |   | 29.40% | 33.83% |  |
| **Smokers**  |  | 20.60% | 15.49% |  |   | 21.24% | 16.36% |  |
| **Marital status c** |  |  |  | \*\*\* |  |  |  | \*\*\* |
| **Living with a partner** |  | 33.28% | 27.70% |  |   | 34.14% | 28.64% |  |
| **Living alone** |  | 66.72% | 72.30% |  |   | 65.86% | 71.36% |  |
| **Sex c** |  |  |  | \* |  |  |  | \*\*\* |
| **Female** |  | 79.05% | 78.08% |  |   | 81.48% | 78.11% |  |
| **Male** |  | 20.95% | 21.92% |  |   | 18.52% | 21.89% |  |

Values are percentages or mean (standard deviation).
a p-values are given as numeric or as \*: ≤0.05, \*\*\*: ≤0.0001

b Welch Two Sample t-test

c Pearson Chi Square association test

**Supplemental Table 3** – Macronutrients and micronutrients official recommended intakes for French adults population a

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Type b | Men |  | Women |
| Proteins (EIWA %) |  | RI | 10-20 |  | 10-20 |
| Lipids (EIWA %) |  | RI | 35-40 |  | 35-40 |
| Saturated fatty acids (EIWA %) |  | MI | <12 |  | <12 |
| Carbohydrates (EIWA %) |  | RI | 40-55 |  | 40-55 |
| Sugars (g) |  | MI | <100 |  | <100 |
| Fibers (g) |  | SI | 30 |  | 30 |
| Vitamin A (µg ER) |  | NRP | 750  |  | 650  |
| Vitamin B1 (mg) |  | SI | 1,5  |  | 1,2  |
| Vitamin B2 (mg) |  | SI | 1,8  |  | 1,5  |
| Vitamin B3 (mg) |  | NRP | 17,4  |  | 14  |
| Vitamin B5 (mg) |  | SI | 5,8  |  | 4,7  |
| Vitamin B6 (mg) |  | SI | 1,8  |  | 1,5  |
| Vitamin B9 (mg) |  | NRP | 330  |  | 330  |
| Vitamin B12 (mg) |  | SI | 4  |  | 4  |
| Vitamin C (mg) |  | NRP | 110  |  | 110  |
| Vitamin D (µg) |  | NRP | 15  |  | 15  |
| Vitamin E (mg) |  | SI | 10,5  |  | 9,9  |
| Calcium (mg) |  | NRP | 1000 (<25 yo) 950 (>25 yo)  |  | 1000 (<25 yo) 950 (>25 yo)  |
| Iron (mg) |  | NRP | 11  |  | 11 if regular menstrual periods16 if heavy menstrual periods |
| Magnesium (mg) |  | NRP | 420  |  | 360  |
| Phosphorus (mg) |  | SI | 700  |  | 700  |
| Potassium |  |  | Equimolar to Sodium |  | Equimolar to Sodium |
| Selenium (µg) |  | SI | 70  |  | 70  |
| Sodium |  |  | Equimolar to Potassium |  | Equimolar to Potassium |
| Zinc (mg) c |  | NRP | 9.4 - 14 |  | 7.5 - 11 |

Abbreviations: EIWA = Energy intake without alcohol

a According to ANSES report

b RI=reference interval, MI=maximum intake, SI=satisfying intake, NRP=nutritional reference for the population
c Average values. Real should account for phytate intake.

Supplemental Table 4 – Food group consumption by quintile of the PNNS-GS2, NutriNet-Santé study, 2009, N=80,965

|  |  | Women |  |  |  |  |  |  |  | Men |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Total | Q1 | Q2 | Q3 | Q4 | Q5 | p a |  | Total | Q1 | Q2 | Q3 | Q4 | Q5 | p a |
| Fruits (g) |  | 195.5 (138.0) | 118.7 (103.5) | 160.7 (112.4) | 189.2 (118.9) | 221.4 (129.1) | 288.2 (157.4) | \*\*\* |  | 221.9 (166.5) | 131.4 (127.8) | 184.6 (139.3) | 215.7 (141.4) | 254.7 (159.3) | 323.6 (191.0) | \*\*\* |
| Vegetables (g) |  | 219.2 (109.4) | 171.5 (95.1) | 197.5 (97.6) | 215.9 (99.3) | 236.8 (107.7) | 274.9 (117.1) | \*\*\* |  | 229.1 (117.2) | 178.5 (99.2) | 209.1 (105.0) | 224.6 (101.5) | 243.5 (111.7) | 289.7 (135.0) | \*\*\* |
| Fruit juices (mL) |  | 51.5 (70.7) | 54.1 (81.2) | 54.2 (72.9) | 52.6 (68.0) | 51.1 (66.2) | 45.4 (63.3) | \*\*\* |  | 60.7 (81.3) | 58.3 (89.2) | 62.4 (82.6) | 62.6 (77.2) | 61.7 (79.1) | 58.8 (77.8) | 0.98 |
| Vegetables juices (mL) |  | 1.7 (13.4) | 1.2 (12.5) | 1.4 (13.3) | 1.4 (10.3) | 1.7 (12.2) | 2.9 (17.5) | \*\*\* |  | 2.0 (17.2) | 1.1 (12.9) | 1.3 (13.6) | 1.6 (13.8) | 2.4 (20.6) | 3.5 (22.6) | \*\*\* |
| Legumes (g) |  | 11.2 (20.3) | 6.9 (16.6) | 8.6 (16.8) | 9.8 (17.4) | 11.8 (19.5) | 18.8 (27.3) | \*\*\* |  | 14.2 (25.6) | 9.3 (20.9) | 10.4 (19.3) | 12.8 (21.7) | 14.9 (24.5) | 23.6 (35.8) | \*\*\* |
| Potatoes and tubers (g) |  | 42.6 (37.3) | 44.1 (41.9) | 42.3 (37.0) | 42.5 (36.5) | 42.3 (35.3) | 42.0 (35.5) | \*\*\* |  | 56.7 (47.6) | 59.9 (51.6) | 55.9 (46.6) | 56.1 (46.1) | 55.8 (45.8) | 55.7 (47.6) | \* |
| Cereals (g) |  | 129.1 (63.2) | 134.0 (67.4) | 134.9 (64.0) | 133.5 (62.5) | 128.9 (60.3) | 114.2 (58.9) | \*\*\* |  | 183.2 (86.1) | 185.8 (87.3) | 191.3 (86.1) | 187.4 (82.6) | 185.1 (86.2) | 166.1 (86.0) | \*\*\* |
| Whole-grain cereals (g) |  | 33.1 (39.2) | 16.9 (28.6) | 25.1 (33.0) | 30.5 (34.3) | 38.4 (39.6) | 54.9 (47.0) | \*\*\* |  | 41.2 (57.1) | 16.9 (36.4) | 29.2 (45.1) | 37.0 (50.3) | 48.2 (59.4) | 74.7 (70.6) | \*\*\* |
| Breakfast cereals (g) |  | 6.4 (13.5) | 4.7 (12.6) | 5.8 (13.2) | 6.3 (13.0) | 6.9 (13.8) | 8.1 (14.7) | \*\*\* |  | 7.8 (17.9) | 3.7 (13.6) | 6.0 (15.3) | 7.2 (16.6) | 9.8 (20.2) | 12.2 (21.5) | \*\*\* |
| Milk and dairy (mL and g) |  | 229.9 (143.4) | 227.4 (153.1) | 237.0 (143.2) | 240.4 (144.1) | 235.9 (140.5) | 208.6 (133.3) | \*\*\* |  | 245.6 (154.4) | 234.6 (156.8) | 249.2 (154.5) | 259.0 (154.1) | 258.4 (151.4) | 227.0 (152.7) | 0.40 |
| Eggs (g) |  | 13.6 (16.6) | 12.6 (17.5) | 13.3 (16.7) | 13.6 (16.3) | 14.0 (16.0) | 14.6 (16.4) | \*\*\* |  | 14.8 (19.0) | 13.9 (21.1) | 14.3 (18.9) | 15.1 (17.6) | 15.2 (18.7) | 15.6 (18.5) | \*\*\* |
| Fish and seafood (g) |  | 37.0 (34.1) | 31.1 (35.8) | 35.3 (33.9) | 38.2 (33.5) | 40.1 (34.0) | 40.1 (32.5) | \*\*\* |  | 44.4 (40.8) | 38.5 (38.7) | 43.6 (40.5) | 45.3 (40.6) | 46.5 (39.6) | 48.0 (43.9) | \*\*\* |
| Meat (g) |  | 64.6 (41.8) | 76.1 (48.0) | 68.3 (41.7) | 65.2 (39.6) | 61.6 (37.9) | 51.5 (36.9) | \*\*\* |  | 86.8 (52.4) | 109.5 (56.6) | 94.1 (52.3) | 86.9 (47.9) | 78.9 (47.6) | 64.3 (45.9) | \*\*\* |
| Processed meat/fish (g) |  | 31.8 (26.3) | 52.3 (32.4) | 37.4 (25.8) | 29.4 (21.6) | 23.4 (17.9) | 16.4 (14.1) | \*\*\* |  | 42.0 (33.7) | 67.1 (38.8) | 51.5 (33.1) | 41.1 (28.7) | 30.6 (24.2) | 19.7 (18.1) | \*\*\* |
| Fatty, sweet or salty food (g) |  | 99.6 (48.2) | 103.3 (56.6) | 104.3 (50.2) | 102.0 (46.8) | 97.8 (43.6) | 90.6 (40.5) | \*\*\* |  | 113.2 (57.9) | 111.6 (65.7) | 115.7 (61.4) | 117.8 (55.4) | 115.0 (53.9) | 106.0 (51.3) | \*\*\* |
| Non-oil fats (g) |  | 60.2 (47.1) | 55.2 (47.7) | 59.1 (45.2) | 61.4 (46.5) | 62.9 (47.4) | 62.4 (48.2) | \*\*\* |  | 66.5 (51.8) | 60.9 (46.8) | 64.4 (51.6) | 68.4 (52.8) | 70.3 (52.1) | 68.4 (54.6) | \*\*\* |
| Non-olive oil (g) |  | 4.3 (5.1) | 4.7 (5.8) | 4.3 (5.0) | 4.2 (4.7) | 4.1 (4.7) | 4.3 (5.0) | \*\*\* |  | 5.4 (6.0) | 6.0 (6.7) | 5.4 (5.8) | 5.2 (5.5) | 5.0 (5.6) | 5.3 (6.1) | \*\*\* |
| Olive oil (g) |  | 4.4 (5.4) | 2.8 (5.0) | 3.7 (5.1) | 4.3 (5.2) | 4.9 (5.4) | 6.2 (5.9) | \*\*\* |  | 4.7 (6.6) | 2.9 (5.5) | 3.9 (5.9) | 4.4 (5.8) | 5.2 (6.4) | 7.1 (8.4) | \*\*\* |
| Unsweetened drinks (mL) |  | 1128.2 (518.6) | 1042.1 (532.3) | 1095.5 (517.7) | 1126.7 (504.7) | 1156.7 (502.8) | 1220.8 (517.6) | \*\*\* |  | 1060.0 (508.3) | 988.5 (534.3) | 1039.0 (499.4) | 1053.4 (489.3) | 1090.1 (502.5) | 1129.4 (504.2) | \*\*\* |
| Sweetened drinks (mL) |  | 39.2 (84.1) | 74.6 (142.8) | 42.3 (78.6) | 31.8 (58.0) | 26.2 (47.3) | 20.9 (36.3) | \*\*\* |  | 49.9 (105.7) | 83.9 (169.1) | 55.8 (108.6) | 44.1 (83.0) | 36.2 (65.6) | 29.2 (48.8) | \*\*\* |
| Alcoholic drinks (mL) |  | 72.8 (107.1) | 123.7 (160.7) | 80.1 (107.2) | 66.0 (89.7) | 53.6 (68.6) | 40.3 (55.6) | \*\*\* |  | 182.3 (207.6) | 328.7 (272.6) | 212.8 (214.4) | 166.9 (172.1) | 122.4 (140.1) | 80.2 (96.1) | \*\*\* |

Values are given per day, as mean (standard deviation), calculated by the residual method.

a p-values are computed using a Linear contrasts trend test on logarithms of values and are given as \*: ≤0.05, \*\*\*: ≤0.0001.

**Supplemental Table 5** – Criterion validity: Pearson correlation coefficient and Cohen kappa coefficients (based on quintiles) for score PNNS-GS2 depending on scores sPNNS-GS2, mPNNS-GS and PNNS-GS (values [95%IC])

|  |  | sPNNS-GS2 |  | mPNNS-GS |  | PNNS-GS |
| --- | --- | --- | --- | --- | --- | --- |
| Pearson’s Correlationcoefficient |  | 0.95 [0.95 ; 0.95] |  | 0.62 [0.61 ; 0.62] |  | 0.58 [0.57 ; 0.58] |
| Weighted Cohen kappa |  | 0.90 [0.90 ; 0.90] |  | 0.58 [0.57 ; 0.58] |  | 0.55 [0.54 ; 0.55] |
| Non-weighted Cohen kappa |  | 0.57 [0.57 ; 0.57] |  | 0.21 [0.20 ; 0.21] |  | 0.19 [0.19 ; 0.20] |