**Ultra-processed beverages and processed meats increase the incidence of hypertension in Mexican women.** Adriana Monge. Online Supplementary Material

Supplemental Table 1. NOVA Classification of items from the Mexican Teachers’ Cohort Food Frequency Questionnaire

|  |  |
| --- | --- |
| **NOVA food groups** | **Mexican Teachers’ Cohort FFQ items** |
| **Unprocessed or minimally processed foods** | **Fruits**: banana, apple, pear, orange/mandarin, lime, grapefruit, grapes, plum, strawberry, melon, watermelon, mango, mammee, prickly pear, zapote, papaya, pineapple, peach, guava, raisins, orange juice, avocado  **Vegetables**: jicama, broccoli, cauliflower, cucumber, green tomato, nopal, pumpkin flower, beets, onions, green beans, carrots, cabbage, hot peppers, zucchini, chayote, lettuce, spinach and other leafy greens, red tomato  **Pulses**: beans\*, lentils, green peas, broad beans, chickpeas  **Nuts**: natural peanuts, walnuts, and almonds  **Dairy**: 1, 2 and 3% milk, butter  **Cereals and tubers**: rice, oats\*, pasta, corn, potato, corn tortilla  **Fish**: fresh fish and seafood (shrimp, octopus, or squid), dry fish  **Meat, poultry and eggs**: eggs, chicken, beef, pork, liver (chicken)  **Beverages**: coffee, tea, atole, agua de jamaica, flavored water (natural)\*  **Mexican food**: *tacos, sope, quesadilla, panucho, pancita, pozole, tamal, carnitas, birria, barbacoa, chicharron* |
| **Processed culinary ingredients** | --- |
| **Processed foods** | **Nuts**: Salted or sugared nuts and seeds  **Dairy**: Oaxaca cheese, Manchego/Chihuahua cheese, fresh cheese, other types  **Cereal**: bolillo/telera, oats\*  **Canned foods**: beans\*, hot peppers  **Fish**: canned tuna and canned sardine  **Meats**: machaca  **Beverages** (fermented alcohol): pulque, beer, wine  **Fast food**: sandwich (meat torta) |
| **Ultra-processed foods** | **Dairy**: flavored yoghurt, fermented dairy (yakult), petite-suisse (danonino), ice-cream  **Cereal and breakfast cereals**: oats, ready-to-eat (RTE) cereal (high and low fiber), cereal bar, RTE loaf of bread (high and low fiber), wheat tortilla  **Added Fats**: cream, cream cheese, margarine  **Sugary products**: jello or flan, cake, cookies, candies, chocolate, jelly/ate/honey, pan dulce, cakes and donuts  **Salty snacks**: chips and saltines  **Processed meats**: sausages, pork and turkey ham, bacon, chorizo/longaniza, other deli meats  **Beverages** (sugar-sweetened): regular and diet cola and soda, flavored water (artificial)\*, orange juice, soy milk  **Beverages** (distilled alcohol): brandy, whisky, tequila, mezcal, rum, aguardiente  **Fast food**: hamburgers, hot dogs, sandwich (processed meat torta), pizza |

Abbreviations. FFQ, food frequency questionnaire

\* To account for the inespecificity in the degree of processing of certain items in our food frequency questionnaire we divided these items into two different groups:

1. Beans were divided into group 1 (60%) and group 3 (40%) to account for natural and canned beans.
2. Flavored water was divided into group 1 (60%) and group 4 (40%) for natural and artificially flavored water.
3. Torta was divided into group 3 and 4 (50%) to account for *tortas* made with deli meats.
4. Orange juice was divided into group 1 and 4 (50%) to account for natural and artificial juice.
5. Oats were divided into group 1 (80%) and 4 (20%).

Supplemental Table 2. Multivariable-adjusted incidence rate ratios and 95% confidence intervals of total UPF consumption, liquid, and solid UPF measured as % kcal of total energy intake among 64,934 women from the Mexican Teachers’ Cohort, adjusted by potential mediators.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Total UPF** | ≤**20%** | **21-25%** | **26-35%** | **36-45%** | **>45%** | **P-Trend** |
| Cases | 585 | 675 | 1517 | 748 | 227 |  |
| Person years | 19777 | 24515 | 59355 | 30102 | 8855 |  |
| Multivariable\* | Reference | 0.96(0.86,1.07) | 0.92(0.84,1.02) | 0.95(0.85,1.06) | 0.98(0.84,1.14) | 0.57 |
| + BMI**†** | Reference | 0.95(0.85,1.06) | 0.91(0.82,1.00) | 0.92(0.83,1.03) | 0.93(0.80,1.09) | 0.22 |
| + Type 2 diabetes**‡** | Reference | 0.96(0.86,1.08) | 0.94(0.85,1.03) | 0.96(0.86,1.08) | 0.99(0.85,1.15) | 0.74 |
|  |  |  |  |  |  |  |
| **Liquid UPF** | ≤**5%** | **6-10%** | **11-15%** | **16-20%** | **>20%** |  |
| Cases | 1703 | 1368 | 449 | 133 | 99 |  |
| Person years | 67382 | 51410 | 16163 | 4700 | 2943 |  |
| Multivariable\* | Reference | 1.06(0.99,1.14) | 1.10(0.99,1.22) | 1.14(0.96,1.36) | 1.34(1.10,1.65) | <0.001 |
| + BMI**†** | Reference | 1.06(0.98,1.13) | 1.08(0.98,1.20) | 1.10(0.92,1.31) | 1.29(1.05,1.58) | <0.001 |
| + Type 2 diabetes**‡** | Reference | 1.07(1.00,1.15) | 1.11(1.00,1.23) | 1.15(0.96,1.37) | 1.35(1.10,1.66) | <0.001 |
|  |  |  |  |  |  |  |
| **Solid UPF** | ≤**15%** | **16-20%** | **21-25%** | **26-30%** | **>30%** |  |
| Cases | 703 | 827 | 838 | 648 | 736 |  |
| Person years | 23403 | 29391 | 32859 | 26444 | 30506 |  |
| Multivariable\* | Reference | 0.97(0.87,1.07) | 0.90(0.81,0.99) | 0.90(0.81,1.00) | 0.91(0.82,1.01) | 0.03 |
| + BMI**†** | Reference | 0.96(0.87,1.06) | 0.89(0.80,0.98) | 0.89(0.80,0.99) | 0.89(0.80,0.99) | 0.01 |
| + Type 2 diabetes**‡** | Reference | 0.97(0.88,1.07) | 0.90(0.81,1.00) | 0.90(0.81,1.01) | 0.91(0.82,1.01) | 0.05 |

Abbreviations. BMI, body mass index; UPF, ultra-processed foods

\* Multivariable model: adjusted for age (years), indigenous (yes/no), internet access (yes/no), insurance (private, social, other), family history of hypertension (yes/no), menopausal status (premenopausal, postmenopausal, unknown), smoking (never, past, current, and missing), physical activity (tertiles), energy (continuous), multivitamin intake (yes/no)

**†** Multivariable model: plus body mass index (categories)

**‡** Multivariable model: plus type 2 diabetes (yes/no)

Supplemental Table 3. Multivariable-adjusted incidence rate ratios and 95% confidence intervals of UPF consumption overall, liquid UPF, and solid UPF measured as % kcal of total energy in the diet in 64,934 women from the Mexican Teachers’ Cohort using a broader definition of hypertension.\*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UPF** | ≤**20%** | **21-25%** | **26-35%** | **36-45%** | **>45%** | *P-*Trend |
| Cases | 791 | 960 | 2117 | 1064 | 355 |  |
| Person years | 18955 | 23390 | 56762 | 28720 | 8377 |  |
| Model**†** | Reference | 1.01(0.92,1.11) | 0.96(0.88,1.04) | 1.00(0.91,1.10) | 1.07(0.94,1.22) | 0.62 |
|  |  |  |  |  |  |  |
| **Liquid UPF** | ≤**5%** | **6-10%** | **11-15%** | **16-20%** | **>20%** |  |
| Cases | 2429 | 1894 | 621 | 197 | 126 |  |
| Person years | 64327 | 49262 | 15388 | 4470 | 2752 |  |
| Model**†** | Reference | 1.03(0.97,1.09) | 1.07(0.98,1.17) | 1.17(1.02,1.36) | 1.21(1.01,1.44) | 0.003 |
|  |  |  |  |  |  |  |
| **Solid UPF** | ≤**15%** | **16-20%** | **21-25%** | **26-30%** | **>30%** |  |
| Cases | 978 | 1149 | 1155 | 922 | 1073 |  |
| Person years | 22398 | 28066 | 31407 | 25270 | 29065 |  |
| Model**†** | Reference | 0.98(0.90,1.07) | 0.90(0.82,0.98) | 0.93(0.85,1.02) | 0.96(0.88,1.05) | 0.27 |

Abbreviations. UPF, ultra-processed foods

\* As a sensitivity analysis we used a broader definition of hypertension: participants who answered any one of three questions on hypertension (diagnosis, treatment, and/or year of diagnosis).

**†** Multivariable model: adjusted for age (years), indigenous (yes/no), internet access (yes/no), insurance (private, social, other), family history of hypertension (yes/no), menopausal status (premenopausal, postmenopausal, unknown), smoking (never, past, current, and missing), physical activity (tertiles), energy intake (kcal per day), multivitamin intake (yes/no)

Supplemental Table 4. Multivariable-adjusted incidence rate ratios and 95% confidence intervals of UPF consumption overall, liquid UPF, and solid UPF measured as % g of total grams in the diet in 64,934 women from the Mexican Teachers’ Cohort.\*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UPF** | ≤**15%** | **16-25%** | **26-35%** | **36-45%** | **>45%** | *P-*Trend |
| Median (IQR) | 10.7(8.2,12.8) | 17.3(16.1,18.6) | 23.6(21.6,26.1) | 32.1(30.9,33.3) | 41.5(37.7,47.9) |  |
| Cases | 1796 | 798 | 804 | 137 | 217 |  |
| Person time | 67371 | 32272 | 29934 | 5555 | 7471 |  |
| Model**†** | Reference | 0.95(0.87,1.03) | 1.04(0.96,1.13) | 0.96(0.81,1.14) | 1.12(0.97,1.30) | 0.17 |
|  |  |  |  |  |  |  |
| **Liquid UPF** | ≤**5%** | **6-10%** | **11-15%** | **16-20%** | **>20%** |  |
| Median (IQR) | 3.3(2.3,4.2) | 7.2(6.1,8.5) | 12.1(11.0,13.4) | 17.0(15.9,18.3) | 26.1(22.4,33.1) |  |
| Cases | 958 | 1209 | 794 | 366 | 425 |  |
| Person time | 37579 | 48027 | 28375 | 13745 | 14870 |  |
| Model**†** | Reference | 1.00(0.92,1.09) | 1.11(1.01,1.23) | 1.05(0.93,1.18) | 1.13(1.01,1.27) | 0.01 |
|  |  |  |  |  |  |  |
| **Solid UPF** | ≤**15%** | **16-20%** | **21-25%** | **26-30%** | **>30%** |  |
| Median (IQR) | 3.6(2.7,4.3) | 6.0(5.5,6.5) | 8.2(7.6,9.0) | 10.8,10.4,11.4) | 14.1(12.9,16.4) |  |
| Cases | 1380 | 925 | 842 | 285 | 320 |  |
| Person time | 47774 | 35415 | 34249 | 11722 | 13444 |  |
| Model**†** | Reference | 0.94(0.87,1.02) | 0.90(0.83,0.98) | 0.89(0.78,1.01) | 0.91(0.81,1.03) | 0.02 |

Abbreviations. UPF, ultra-processed foods

\* As a sensitivity analysis we used % of UPF g in total diet instead of % of UPF kcal in total diet as the exposure.

**†** Multivariable model: adjusted for age (years), indigenous (yes/no), internet access (yes/no), insurance (private, social, other), family history of hypertension (yes/no), menopausal status (premenopausal, postmenopausal, unknown), smoking (never, past, current, and missing), physical activity (tertiles), energy intake (kcal per day), multivitamin intake (yes/no)

Supplemental Table 5. Age-standardized characteristics of 75,980 Mexican women from the Mexican Teachers’ Cohort at baseline: comparison between our analytical sample and non-responders to the follow-up questionnaire.\*

|  |  |  |
| --- | --- | --- |
|  | Follow-up | |
| No  (n=11,046) | Yes  (n=64,934) |
| UPF, %kcal/day | 29.4±9.5 | 29.8±9.4 |
| Liquid UPF, %kcal/day | 6.4±4.8 | 6.4±4.8 |
| Solid UPF, %kcal/day | 23.0±9.0 | 23.4±8.9 |
| Age, years**†** | 42.6±8.0 | 41.7±7.2 |
| Body mass index, categories |  |  |
| - Normal weight, % | 33.7 | 33.7 |
| - Overweight, % | 37.6 | 38.2 |
| - Obese, % | 19.5 | 19.3 |
| - Unknown, % | 9.2 | 8.8 |
| Insurance - serious condition |  |  |
| - Social Security, % | 70.8 | 69.7 |
| - Private, % | 19.9 | 18.2 |
| - Other, % | 9.2 | 8.8 |
| Internet use, % | 41.9 | 50.2 |
| Mexican Regions**†** |  |  |
| - North, % | 16.4 | 19.9 |
| - Central, % | 12.9 | 16.6 |
| - Mexico City and State of Mexico, % | 20.2 | 25.0 |
| - South, % | 50.6 | 38.4 |
| Family history of hypertension, % | 55.3 | 56.8 |
| Type 2 Diabetes, % | 3.0 | 2.8 |
| Hypercholesterolemia, % | 9.3 | 9.6 |
| Menopausal status |  |  |
| - Premenopausal, % | 76.1 | 77.7 |
| - Postmenopausal, % | 14.3 | 13.6 |
| - Unknown, % | 9.6 | 8.6 |
| Intake of multivitamins, % | 33.9 | 33.3 |
| Smoking, categories |  |  |
| - Current smoker, % | 10.0 | 9.1 |
| - Past smoker, % | 10.8 | 11.1 |
| - Never smoker, % | 75.9 | 76.9 |
| - Unknown, % | 3.3 | 3.0 |
| Total energy, kcal/day | 1816±729 | 1820±693 |
| Dairy, %kcal/day | 2.1±2.1 | 2.2±2.1 |
| Added Fats, %kcal/day | 1.0±1.1 | 1.1±1.1 |
| Sugary products, %kcal/day | 9.3±6.6 | 9.4±6.5 |
| SSB, %kcal/day | 6.0±4.7 | 6.0±4.8 |
| Alcohol, %kcal/day | 0.2±0.4 | 0.2±0.4 |
| Processed meats, %kcal/day | 1.9±1.5 | 1.9±1.5 |
| Cereals, %kcal/day | 5.8±4.6 | 5.9±4.5 |
| Salty snacks, %kcal/day | 0.9±1.3 | 0.9±1.3 |
| Fast foods, %kcal/day | 2.5±2.0 | 2.5±2.0 |

Abbreviations: SSB, sugar-sweetened beverages; UPF, ultra-processed foods

\*Values are mean ± SD for continuous variables and percent for categorical variables. Values are age standardized to the age distribution of the study population. Values of categorical variables may not add up to 100% due to rounding.

**†**Variable is not age adjusted

Supplemental Table 6. Age-standardized characteristics of 82,115 Mexican women from the Mexican Teachers’ Cohort at baseline: comparison between our analytical sample and women with an invalid food frequency questionnaire.\*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Food frequency questionnaire | | |
|  | Valid (n=64934) | Invalid (n=17181) | |
| Age, years**†** | 41.7(7.2) | 42.1(7.6) | |
| Ethnicity, % | 7.8 | 7.8 | |
| Mexican Regions**†** | | |  |
| - North, % | 19.9 | 12.0 | |
| - Central, % | 16.6 | 35.9 | |
| - Mexico City and State of Mexico, % | 25.0 | 13.6 | |
| - South, % | 38.4 | 38.5 | |
| Internet use, % | 50.1 | 41.7 | |
| Insurance - serious condition | | | |
| - Social Security, % | 69.7 | 72.7 | |
| - Private, % | 18.2 | 17.6 | |
| - Other, % | 12.1 | 9.7 | |
| Smoking, categories | | |  |
| - Current smoker, % | 9.1 | 8.4 | |
| - Past smoker, % | 11.0 | 12.1 | |
| - Never smoker, % | 77.0 | 71.4 | |
| - Unknown, % | 2.9 | 8.0 | |
| Physical Activity, METs/week | | | |
| - Tertile 1, % | 31.9 | 37.2 | |
| - Tertile 2, % | 34.3 | 29.7 | |
| - Tertile 3, % | 33.8 | 33.1 | |
| Menopausal status | | |  |
| - Premenopausal, % | 78.1 | 74.6 | |
| - Postmenopausal, % | 13.4 | 13.0 | |
| - Unknown, % | 8.5 | 12.4 | |
| Body mass index, kg/m² | 27.0(4.4) | 26.9(4.5) | |
| Body mass index, categories | | | |
| - Normal weight, % | 33.7 | 34.3 | |
| - Overweight, % | 38.2 | 35.7 | |
| - Obese, % | 19.3 | 18.9 | |
| - Unknown, % | 8.8 | 11.1 | |
| Family history of hypertension, % | 56.8 | 36.7 | |
| Diabetes mellitus, % | 2.8 | 2.7 | |
| Hypercholesterolemia, % | 9.6 | 7.3 | |
| Intake of multivitamins, % | 33.3 | 21.2 | |

Abbreviations: UPF, ultra-processed foods; METs, metabolic equivalent of task

\*Values are mean ± SD for continuous variables and percent for categorical variables. Values are age standardized to the age distribution of the study population. Values of categorical variables may not add up to 100% due to rounding.

**†**Variable is not age adjusted