**Table A.1**. Availability of total or inorganic arsenic concentrations for food items included in the

NBDPS FFQ

|  |  |  |
| --- | --- | --- |
| NBDPS FFQ Item | Total Arsenic | Inorganic Arsenic |
| Skim or low-fat milk (8 oz. glass) | x | x |
| Whole milk (8 oz. glass) | x | x |
| Yogurt (1 cup) | x |  |
| Ice cream (1/2 cup) | x |  |
| Cottage or ricotta cheese (1/2 cup) | x |  |
| Other cheese e.g. American, cheddar, etc., plain or as part of a dish (1 slice or 1 oz. serving) | x |  |
| Margarine (pat), added to food or bread; exclude use in cooking | x |  |
| Butter (pat), added to food or bread; exclude use in cooking | x | x |
| Fresh apples or pears (1) | x | x |
| Oranges (1) | x | x |
| Orange juice (small glass) | x | x |
| Peaches, apricots, plums, or nectarines (1 fresh or 1/2 cup canned) | x | x |
| Bananas (1) | x | x |
| Cantaloupe (1/4 melon) | x |  |
| Avocado (1) or guacamole (1 cup) | x |  |
| Other fruits, fresh, frozen, or canned (1/2 cup) | x | x |
| Tomatoes (1) or tomato juice (small glass) | x | x |
| String beans (1/2 cup) | x | x |
| Broccoli (1/2 cup) | x |  |
| Cabbage, cauliflower, or brussel sprouts (1/2 cup) | x |  |
| Carrots, raw (1/2 carrot or 2-4 sticks) | x | x |
| Carrots, cooked (1/2 cup) | x | x |
| Corn (1 ear or 1/2 cup frozen, canned) | x | x |
| Peas or lima beans (1/2 cup frozen, canned) | x | x |
| Yams or sweet potatoes (1/2 cup) | x |  |
| Spinach or collard greens, cooked (1/2 cup) | x | x |
| Refried beans (1 cup) | x |  |
| Beans or lentils, baked or dried (1/2 cup) | x |  |
| Yellow (winter) squash (1/2 cup) | x |  |
| Raw chile peppers, jalapeño (1) |  |  |
| Salsa (fruit or tomato) (1 cup) | x |  |
| Eggs (1) | x | x |
| Chicken or turkey without skin (4-6 oz.) | x | x |
| Bacon (2 slices) | x |  |
| Hot dogs (1) | x |  |
| Processed meats, e.g. sausage, salami, bologna, chorizo, etc. (piece or slice) | x |  |
| Liver (3-4 oz.) | x |  |
| Chicken Livers (1 oz.) |  |  |
| Organ meats, Barbacoa, Menudo, sweetbreads, tongue, intestines (3-4 oz.) |  |  |
| Hamburger (1 patty) | x |  |
| Beef, pork, lamb, or cabrito as a sandwich or mixed dish, e.g. stew, casserole, lasagna, etc. | x | x |
| Beef, pork, lamb, or cabrito as a main dish, e.g. steak, roast, ham, etc. (4-6 oz.) | x | x |
| Fish (3-5 oz.) | x | x |
| Chocolate (1 oz.) | x |  |
| Candy without chocolate (1 oz.) | x |  |
| Pie (slice) | x |  |
| Cake (slice) | x |  |
| Cookies (1) | x |  |
| White bread (slice), including pita bread | x |  |
| Dark bread (slice), including wheat pita bread | x |  |
| French fried potatoes (4 oz.) | x |  |
| Potatoes, baked, boiled (1), or mashed (1 cup) | x | x |
| Rice or pasta e.g. Spanish rice, spaghetti, noodles, etc. (1 cup) | x | x |
| Tortilla (1) | x |  |
| Potato chips or corn chips (small bag or 1 oz.) | x |  |
| Nuts (small packet or 1 oz.) | x |  |
| Peanut butter (1 Tbs) | x | x |
| Oil and vinegar dressing e.g. Italian (1 Tbs) | x |  |

NBDPS: National Birth Defects Prevention Study; FFQ: food frequency questionnaire.

Note: four additional FFQ items (soy milk; Hawaiian punch, lemonade, or other fruit drinks; tofu, tempeh or soy burgers; biscuits, scones, croissants and muffins) that were only included in the interview from 2006 forward were not included in analyses.

**Table A.2.** Distributions of child and maternal characteristics among case children with central nervous defects, National Birth Defects

Prevention Study, 1997-2011

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Anencephaly | Encephalocele | Spina bifida | Cerebellar hypoplasia | Dandy-Walker malformation | Holoprosencephaly | Hydrocephalus |
| Characteristic | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a |
| *Child* |  |  |  |  |  |  |  |
| Sex |  |  |  |  |  |  |  |
| Male | 203 (46.0) | 61 (44.2) | 472 (50.6) | 18 (60.0) | 55 (59.1) | 38 (36.5) | 172 (55.0) |
| Female | 238 (54.0) | 77 (55.8) | 460 (49.4) | 12 (40.0) | 38 (40.9) | 66 (63.5) | 141 (45.0) |
| Missing | 58 | 3 | 18 | 0 | 0 | 0 | 0 |
| Plurality |  |  |  |  |  |  |  |
| 1 | 469 (94.0) | 134 (95.0) | 916 (96.4) | 29 (96.7) | 87 (93.6) | 98 (94.2) | 292 (93.3) |
| 2+ | 30 (6.0) | 7 (5.0) | 34 (3.6) | 1 (3.3) | 6 (6.5) | 6 (5.8) | 21 (6.7) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| First-degree family history of birth defect |  |  |  |  |  |  |  |
| Yes | 3 (0.6) | 2 (1.4) | 16 (1.7) | 0 (0.0) | 0 (0.0) | 2 (1.9) | 9 (2.9) |
| No | 496 (99.4) | 139 (98.6) | 934 (98.3) | 30 (100.0) | 93 (100.0) | 102 (98.1) | 304 (97.1) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Maternal* |  |  |  |  |  |  |  |
| Age at delivery (years) |  |  |  |  |  |  |  |
| <20 | 43 (8.6) | 20 (14.2) | 92 (9.7) | 1 (3.3) | 10 (10.8) | 11 (10.6) | 33 (10.5) |
| 20-24 | 112 (22.4) | 29 (20.6) | 206 (21.7) | 6 (20.0) | 23 (24.7) | 25 (24.0) | 83 (26.5) |
| 25-29 | 163 (32.7) | 37 (26.2) | 295 (31.1) | 12 (40.0) | 17 (18.3) | 29 (27.9) | 94 (30.0) |
| 30-34 | 116 (23.2) | 32 (22.7) | 223 (23.5) | 8 (26.7) | 29 (31.2) | 25 (24.0) | 69 (22.0) |
| 35-39 | 54 (10.8) | 16 (11.3) | 103 (10.8) | 2 (6.7) | 11 (11.8) | 12 (11.5) | 29 (9.3) |
| ≥40 | 11 (2.2) | 7 (5.0) | 31 (3.3) | 1 (3.3) | 3 (3.2) | 2 (1.9) | 5 (1.6) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Education at delivery (years) |  |  |  |  |  |  |  |
| 0-8 | 36 (7.2) | 8 (5.7) | 33 (3.5) | 1 (3.3) | 6 (6.5) | 8 (7.7) | 13 (4.2) |
| 9-11 | 57 (11.5) | 21 (15.0) | 106 (11.2) | 4 (13.3) | 12 (13.0) | 18 (17.3) | 43 (13.8) |
| 12 | 132 (26.6) | 41 (29.3) | 260 (27.5) | 8 (26.7) | 23 (25.0) | 32 (30.8) | 86 (27.6) |
| 13-15 | 136 (27.4) | 36 (25.7) | 287 (30.4) | 7 (23.3) | 27 (29.3) | 25 (24.0) | 85 (27.2) |
| ≥16 | 136 (27.4) | 34 (24.3) | 258 (27.3) | 10 (33.3) | 24 (26.1) | 21 (20.2) | 85 (27.2) |
| Missing | 2 | 1 | 6 | 0 | 1 | 0 | 1 |
| Race/ethnicity |  |  |  |  |  |  |  |
| Non-Hispanic White | 261 (52.3) | 71 (50.4) | 545 (57.4) | 20 (66.7) | 42 (45.2) | 44 (42.3) | 203 (64.9) |
| Non-Hispanic Black | 41 (8.2) | 23 (16.3) | 77 (8.1) | 6 (20.0) | 30 (32.3) | 15 (14.4) | 38 (12.1) |
| Hispanic | 158 (31.7) | 36 (25.5) | 270 (28.4) | 3 (10.0) | 15 (16.1) | 36 (34.6) | 59 (18.8) |
| Other | 39 (7.8) | 11 (7.8) | 58 (6.1) | 1 (3.3) | 6 (6.5) | 9 (8.7) | 13 (4.2) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-pregnancy Body Mass Index (kg/m2) |  |  |  |  |  |  |  |
| <18.5 | 25 (5.0) | 5 (3.5) | 30 (3.2) | 1 (3.3) | 5 (5.4) | 8 (7.7) | 28 (8.9) |
| 18.5-24.9 | 243 (48.7) | 78 (55.3) | 427 (44.9) | 16 (53.3) | 38 (40.9) | 41 (39.4) | 157 (50.2) |
| 25.0-29.9 | 121 (24.2) | 23 (16.3) | 236 (24.8) | 6 (20.0) | 26 (28.0) | 26 (25.0) | 72 (23.0) |
| ≥30.0 | 110 (22.0) | 35 (24.8) | 257 (27.1) | 7 (23.3) | 24 (25.8) | 29 (27.9) | 56 (17.9) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gravidity |  |  |  |  |  |  |  |
| 0 | 137 (27.5) | 44 (31.2) | 239 (25.2) | 8 (26.7) | 24 (25.8) | 17 (16.3) | 104 (33.3) |
| 1 | 139 (27.9) | 38 (27.0) | 270 (28.5) | 11 (36.7) | 24 (25.8) | 31 (29.8) | 85 (27.2) |
| ≥2 | 223 (44.7) | 59 (41.8) | 440 (46.4) | 11 (36.7) | 45 (48.4) | 56 (53.8) | 123 (39.4) |
| Missing | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| Folic acid supplementation b |  |  |  |  |  |  |  |
| Yes | 281 (57.6) | 78 (56.1) | 523 (56.1) | 27 (90.0) | 80 (86.0) | 79 (79.0) | 278 (89.7) |
| No | 207 (42.4) | 61 (43.9) | 410 (43.9) | 3 (10.0) | 13 (14.0) | 21 (21.0) | 32 (10.3) |
| Missing | 11 | 2 | 17 | 0 | 0 | 4 | 3 |
| Pre-pregnancy dietary folate equivalents (µg/day) |  |  |  |  |  |  |  |
| <600 | 367 (73.5) | 102 (72.3) | 688 (72.4) | 22 (73.3) | 73 (78.5) | 76 (73.1) | 218 (69.6) |
| ≥600 | 132 (26.5) | 39 (27.7) | 262 (27.6) | 8 (26.7) | 20 (21.5) | 28 (26.9) | 95 (30.4) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-pregnancy total energy intake (calories/day) |  |  |  |  |  |  |  |
| Low | 159 (31.9) | 58 (41.1) | 358 (37.7) | 12 (40.0) | 35 (37.6) | 31 (29.8) | 101 (32.3) |
| Middle | 167 (33.5) | 40 (28.4) | 286 (30.1) | 10 (33.3) | 32 (34.4) | 38 (36.5) | 106 (33.9) |
| High | 173 (34.7) | 43 (30.5) | 306 (32.2) | 8 (26.7) | 26 (28.0) | 35 (33.7) | 106 (33.9) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alcohol consumption b |  |  |  |  |  |  |  |
| No drinking | 361 (73.4) | 95 (67.9) | 617 (65.6) | 19 (63.3) | 67 (72.8) | 66 (64.1) | 204 (66.4) |
| Drinking with no binge episodes | 83 (16.9) | 30 (21.4) | 193 (20.5) | 6 (20.0) | 18 (19.6) | 23 (22.3) | 60 (19.5) |
| Drinking and ≥ 1 binge episode | 48 (9.8) | 15 (10.7) | 131 (13.9) | 5 (16.7) | 7 (7.6) | 14 (13.6) | 43 (14.0) |
| Missing | 7 | 1 | 9 | 0 | 1 | 1 | 6 |
| Tobacco smoking exposure b |  |  |  |  |  |  |  |
| No active and passive smoking | 343 (73.0) | 86 (61.4) | 641 (68.6) | 18 (62.1) | 61 (67.0) | 72 (71.3) | 188 (60.6) |
| Active smoking only | 19 (4.0) | 11 (7.9) | 65 (7.0) | 3 (10.3) | 7 (7.7) | 8 (7.9) | 24 (7.7) |
| Passive smoking only | 82 (17.4) | 27 (19.3) | 136 (14.5) | 5 (17.2) | 16 (17.6) | 11 (10.9) | 54 (17.4) |
| Active and passive smoking | 26 (5.5) | 16 (11.4) | 93 (9.9) | 3 (10.3) | 7 (7.7) | 10 (9.69) | 44 (14.2) |
| Missing | 29 | 1 | 15 | 1 | 2 | 3 | 3 |
| NBDPS site |  |  |  |  |  |  |  |
| Arkansas | 65 (13.0) | 15 (10.6) | 117 (12.3) | 10 (33.3) | 10 (10.8) | 13 (12.5) | 41 (13.1) |
| California | 97 (19.4) | 16 (11.3) | 173 (18.2) | 3 (10.0) | 13 (14.0) | 15 (14.4) | 33 (10.5) |
| CDC/Georgia | 61 (12.2) | 19 (13.5) | 115 (12.1) | 4 (13.3) | 11 (11.8) | 8 (7.7) | 29 (9.3) |
| Iowa | 53 (10.6) | 17 (12.1) | 127 (13.4) | 4 (13.3) | 4 (4.3) | 7 (6.7) | 52 (16.6) |
| Massachusetts | 19 (3.8) | 10 (7.1) | 61 (6.4) | 2 (6.7) | 9 (9.7) | 7 (6.7) | 23 (7.3) |
| New Jersey | 7 (1.4) | 5 (3.5) | 37 (3.9) | 0 (0.0) | 4 (4.3) | 5 (4.8) | 16 (5.1) |
| New York | 12 (2.4) | 9 (6.4) | 57 (6.0) | 1 (3.3) | 11 (11.8) | 8 (7.7) | 31 (9.9) |
| North Carolina | 66 (13.2) | 16 (11.3) | 79 (8.3) | 3 (10.0) | 14 (15.1) | 3 (2.9) | 33 (10.5) |
| Texas | 70 (14.0) | 18 (12.8) | 102 (10.7) | 1 (3.3) | 9 (9.7) | 20 (19.2) | 32 (10.2) |
| Utah | 49 (9.8) | 16 (11.3) | 82 (8.6) | 2 (6.7) | 8 (8.6) | 18 (17.3) | 23 (7.3) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NBDPS: National Birth Defects Prevention Study.

a Due to rounding, proportions may not total to 100.

b During the period one month before [B1] through the third month following [M3] conception.

**Table A.3.** Distributions of child and maternal characteristics among cases with ear, eye, and craniofacial defects, National Birth Defects

Prevention Study, 1997-2011

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Anotia/microtia | Anopthalmos/ micropthalmos | Cataracts | Glaucoma/anterior chamber defects | Choanal atresia | Cleft lip w/wo cleft palate | Cleft palate |
| Characteristic | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a |
| *Child* |  |  |  |  |  |  |  |
| Sex |  |  |  |  |  |  |  |
| Male | 228 (58.6) | 64 (51.6) | 118 (45.7) | 65 (55.6) | 24 (31.2) | 1,606 (66.3) | 489 (41.8) |
| Female | 161 (41.4) | 60 (48.4) | 140 (54.3) | 52 (44.4) | 53 (68.8) | 817 (33.7) | 681 (58.2) |
| Missing | 0 | 1 | 0 | 0 | 0 | 3 | 1 |
| Plurality |  |  |  |  |  |  |  |
| 1 | 374 (96.1) | 122 (97.6) | 244 (94.6) | 111 (94.9) | 73 (94.8) | 2,324 (95.8) | 1,126 (96.2) |
| 2+ | 15 (3.9) | 3 (2.4) | 14 (5.4) | 6 (5.1) | 4 (5.2) | 102 (4.2) | 45 (3.8) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| First-degree family history of birth defect |  |  |  |  |  |  |  |
| Yes | 7 (1.8) | 1 (0.8) | 11 (4.3) | 6 (5.1) | 1 (1.3) | 150 (6.2) | 69 (5.9) |
| No | 382 (98.2) | 124 (99.2) | 247 (95.7) | 111 (94.9) | 76 (98.7) | 2,276 (93.8) | 1,102 (94.1) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Maternal* |  |  |  |  |  |  |  |
| Age at delivery (years) |  |  |  |  |  |  |  |
| <20 | 44 (11.3) | 13 (10.4) | 17 (6.6) | 7 (6.0) | 1 (1.3) | 237 (9.8) | 87 (7.4) |
| 20-24 | 92 (23.7) | 28 (22.4) | 53 (20.5) | 33 (28.2) | 11 (14.3) | 580 (23.9) | 239 (20.4) |
| 25-29 | 104 (26.7) | 37 (29.6) | 85 (32.9) | 35 (29.9) | 17 (22.1) | 696 (28.7) | 324 (27.7) |
| 30-34 | 90 (23.1) | 30 (24.0) | 63 (24.4) | 25 (21.4) | 30 (39.0) | 568 (23.4) | 308 (26.3) |
| 35-39 | 54 (13.9) | 13 (10.4) | 32 (12.4) | 13 (11.1) | 16 (20.8) | 288 (11.9) | 172 (14.7) |
| ≥40 | 5 (1.3) | 4 (3.2) | 8 (3.1) | 4 (3.4) | 2 (2.6) | 57 (2.3) | 41 (3.5) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Education at delivery (years) |  |  |  |  |  |  |  |
| 0-8 | 36 (9.4) | 5 (4.0) | 13 (5.1) | 1 (0.9) | 0 (0.0) | 83 (3.4) | 45 (3.9) |
| 9-11 | 57 (14.8) | 16 (12.9) | 22 (8.6) | 17 (14.7) | 4 (5.3) | 320 (13.3) | 103 (8.8) |
| 12 | 93 (24.2) | 38 (30.6) | 55 (21.4) | 17 (14.7) | 17 (22.4) | 657 (27.3) | 296 (25.4) |
| 13-15 | 94 (24.5) | 34 (27.4) | 74 (28.8) | 45 (38.8) | 18 (23.7) | 651 (27.0) | 355 (30.4) |
| ≥16 | 104 (27.1) | 31 (25.0) | 93 (36.2) | 36 (31.0) | 37 (48.7) | 700 (29.0) | 367 (31.5) |
| Missing | 5 | 1 | 1 | 1 | 1 | 15 | 5 |
| Race/ethnicity |  |  |  |  |  |  |  |
| Non-Hispanic White | 139 (35.7) | 67 (54.0) | 170 (65.9) | 69 (59.0) | 63 (82.9) | 1,580 (65.1) | 792 (67.6) |
| Non-Hispanic Black | 11 (2.8) | 19 (15.3) | 30 (11.6) | 21 (17.9) | 5 (6.6) | 130 (5.4) | 81 (6.9) |
| Hispanic | 203 (52.2) | 29 (23.4) | 42 (16.3) | 20 (17.1) | 7 (9.2) | 540 (22.3) | 214 (18.3) |
| Other | 36 (9.3) | 9 (7.3) | 16 (6.2) | 7 (6.0) | 1 (1.3) | 176 (7.3) | 84 (7.2) |
| Missing | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Pre-pregnancy Body Mass Index (kg/m2) |  |  |  |  |  |  |  |
| <18.5 | 17 (4.4) | 7 (5.6) | 9 (3.5) | 2 (1.7) | 4 (5.2) | 150 (6.2) | 68 (5.8) |
| 18.5-24.9 | 192 (49.4) | 55 (44.0) | 140 (54.3) | 65 (55.6) | 39 (50.6) | 1,275 (52.6) | 594 (50.7) |
| 25.0-29.9 | 104 (26.7) | 31 (24.8) | 56 (21.7) | 26 (22.2) | 24 (31.2) | 532 (21.9) | 280 (23.9) |
| ≥30.0 | 76 (19.5) | 32 (25.6) | 53 (20.5) | 24 (20.5) | 10 (13.0) | 469 (19.3) | 229 (19.6) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gravidity |  |  |  |  |  |  |  |
| 0 | 115 (29.6) | 38 (30.4) | 89 (34.5) | 32 (27.4) | 14 (18.2) | 714 (29.4) | 320 (27.3) |
| 1 | 101 (26.0) | 31 (24.8) | 73 (28.3) | 46 (39.3) | 24 (31.2) | 701 (28.9) | 351 (30.0) |
| ≥2 | 173 (44.5) | 56 (44.8) | 96 (37.2) | 39 (33.3) | 39 (50.6) | 1,010 (41.6) | 500 (42.7) |
| Missing | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Folic acid supplementation b |  |  |  |  |  |  |  |
| Yes | 318 (82.4) | 110 (88.0) | 228 (89.4) | 103 (88.0) | 71 (92.2) | 2,092 (86.9) | 1,018 (88.3) |
| No | 68 (17.6) | 15 (12.0) | 27 (10.6) | 14 (12.0) | 6 (7.8) | 316 (13.1) | 135 (11.7) |
| Missing | 3 | 0 | 3 | 0 | 0 | 18 | 18 |
| Pre-pregnancy dietary folate equivalents (µg/day) |  |  |  |  |  |  |  |
| <600 | 278 (71.5) | 91 (72.8) | 188 (72.9) | 80 (68.4) | 62 (80.5) | 1,754 (72.3) | 858 (73.3) |
| ≥600 | 111 (28.5) | 34 (27.2) | 70 (27.1) | 37 (31.6) | 15 (19.5) | 672 (27.7) | 313 (26.7) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-pregnancy total energy intake (calories/day) |  |  |  |  |  |  |  |
| Low | 119 (30.6) | 34 (27.2) | 107 (41.5) | 48 (41.0) | 22 (28.6) | 870 (35.9) | 432 (36.9) |
| Middle | 118 (30.3) | 45 (36.0) | 77 (29.8) | 31 (26.5) | 38 (49.4) | 789 (32.5) | 381 (32.5) |
| High | 152 (39.1) | 46 (36.8) | 74 (28.7) | 38 (32.5) | 17 (22.1) | 767 (31.6) | 358 (30.6) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alcohol consumption b |  |  |  |  |  |  |  |
| No drinking | 255 (66.2) | 86 (69.4) | 158 (62.0) | 88 (76.5) | 48 (63.2) | 1,487 (62.0) | 677 (58.5) |
| Drinking with no binge episodes | 83 (21.6) | 30 (24.2) | 62 (24.3) | 19 (16.5) | 21 (27.6) | 582 (24.3) | 332 (28.7) |
| Drinking and ≥ 1 binge episode | 47 (12.2) | 8 (6.5) | 35 (13.7) | 8 (7.0) | 7 (9.2) | 331 (13.8) | 149 (12.9) |
| Missing | 4 | 1 | 3 | 2 | 1 | 26 | 13 |
| Tobacco smoking exposure b |  |  |  |  |  |  |  |
| No active and passive smoking | 276 (71.7) | 81 (66.4) | 177 (68.6) | 82 (70.7) | 55 (72.4) | 1,492 (62.0) | 744 (63.9) |
| Active smoking only | 26 (6.8) | 14 (11.5) | 23 (8.9) | 1 (0.9) | 8 (10.5) | 221 (9.2) | 116 (10.0) |
| Passive smoking only | 50 (13.0) | 16 (13.1) | 36 (14.0) | 23 (19.8) | 6 (7.9) | 326 (13.5) | 155 (13.3) |
| Active and passive smoking | 33 (8.6) | 11 (9.0) | 22 (8.5) | 10 (8.6) | 7 (9.2) | 367 (15.3) | 150 (12.9) |
| Missing | 4 | 3 | 0 | 1 | 1 | 20 | 6 |
| NBDPS site |  |  |  |  |  |  |  |
| Arkansas | 28 (7.2) | 28 (22.4) | 52 (20.2) | 18 (15.4) | 6 (7.8) | 282 (11.6) | 134 (11.4) |
| California | 94 (24.2) | 9 (7.2) | 16 (6.2) | 10 (8.5) | 3 (3.9) | 380 (15.7) | 140 (12.0) |
| CDC/Georgia | 16 (4.1) | 12 (9.6) | 34 (13.2) | 20 (17.1) | 7 (9.1) | 229 (9.4) | 136 (11.6) |
| Iowa | 20 (5.1) | 13 (10.4) | 28 (10.9) | 11 (9.4) | 10 (13.0) | 263 (10.8) | 118 (10.1) |
| Massachusetts | 33 (8.5) | 20 (16.0) | 36 (14.0) | 19 (16.2) | 14 (18.2) | 294 (12.1) | 188 (16.1) |
| New Jersey | 35 (9.0) | 5 (4.0) | 15 (5.8) | 3 (2.6) | 5 (6.5) | 93 (3.8) | 58 (5.0) |
| New York | 28 (7.2) | 10 (8.0) | 14 (5.4) | 5 (4.3) | 13 (16.9) | 204 (8.4) | 110 (9.4) |
| North Carolina | 23 (5.9) | 9 (7.2) | 10 (3.9) | 4 (3.4) | 3 (3.9) | 174 (7.2) | 103 (8.8) |
| Texas | 69 (17.7) | 8 (6.4) | 9 (3.5) | 6 (5.1) | 6 (7.8) | 243 (10.0) | 90 (7.7) |
| Utah | 43 (11.1) | 11 (8.8) | 44 (17.1) | 21 (17.9) | 10 (13.0) | 264 (10.9) | 94 (8.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NBDPS: National Birth Defects Prevention Study.

a Due to rounding, proportions may not total to 100.

b During the period one month before [B1] through the third month following [M3] conception.

**Table A.4.** Distributions of child and maternal characteristics among cases with gastrointestinal defects, National Birth Defects

Prevention Study, 1997-2011

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Anorectal atresia/stenosis | Biliary atresia | Colonic atresia/stenosis | Duodenal atresia/stenosis | Intestinal atresia/stenosis | Esophageal atresia |
| Characteristic | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a |
| *Child* |  |  |  |  |  |  |
| Sex |  |  |  |  |  |  |
| Male | 262 (63.0) | 68 (48.2) | 19 (42.2) | 58 (46.0) | 168 (47.9) | 142 (50.5) |
| Female | 154 (37.0) | 73 (51.8) | 26 (57.8) | 68 (54.0) | 183 (52.1) | 139 (49.5) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| Plurality |  |  |  |  |  |  |
| 1 | 393 (94.5) | 135 (95.7) | 43 (95.6) | 122 (96.8) | 320 (91.2) | 251 (89.3) |
| 2+ | 23 (5.5) | 6 (4.3) | 2 (4.4) | 4 (3.2) | 31 (8.8) | 30 (10.7) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| First-degree family history of birth defect |  |  |  |  |  |  |
| Yes | 9 (2.2) | 0 (0.0) | 0 (0.0) | 3 (2.4) | 1 (0.3) | 4 (1.4) |
| No | 407 (97.8) | 141 (100.0) | 45 (100.0) | 123 (97.6) | 350 (99.7) | 277 (98.6) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| *Maternal* |  |  |  |  |  |  |
| Age at delivery (years) |  |  |  |  |  |  |
| <20 | 33 (7.9) | 14 (9.9) | 15 (33.3) | 15 (11.9) | 37 (10.5) | 20 (7.1) |
| 20-24 | 102 (24.5) | 37 (26.2) | 16 (35.6) | 29 (23.0) | 87 (24.8) | 47 (16.7) |
| 25-29 | 108 (26.0) | 37 (26.2) | 7 (15.6) | 30 (23.8) | 94 (26.8) | 66 (23.5) |
| 30-34 | 112 (26.9) | 38 (27.0) | 2 (4.4) | 35 (27.8) | 72 (20.5) | 72 (25.6) |
| 35-39 | 55 (13.2) | 10 (7.1) | 5 (11.1) | 14 (11.1) | 50 (14.2) | 57 (20.3) |
| ≥40 | 6 (1.4) | 5 (3.5) | 4(8.9) | 3 (2.4) | 11 (3.1) | 19 (6.8) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| Education at delivery (years) |  |  |  |  |  |  |
| 0-8 | 20 (4.8) | 2 (1.4) | 1 (2.2) | 8 (6.3) | 19 (5.4) | 11 (3.9) |
| 9-11 | 50 (12.0) | 18 (12.9) | 11 (24.4) | 14 (11.1) | 52 (14.9) | 14 (5.0) |
| 12 | 119 (28.7) | 29 (20.9) | 19 (42.2) | 26 (20.6) | 93 (26.6) | 57 (20.3) |
| 13-15 | 110 (26.5) | 41 (29.5) | 8 (17.8) | 33 (26.2) | 89 (25.5) | 74 (26.3) |
| ≥16 | 116 (28.0) | 49 (35.3) | 6 (13.3) | 45 (35.7) | 96 (27.5) | 125 (44.5) |
| Missing | 1 | 2 | 0 | 0 | 2 | 0 |
| Race/ethnicity |  |  |  |  |  |  |
| Non-Hispanic White | 230 (55.3) | 75 (53.2) | 19 (42.2) | 69 (54.8) | 168 (47.9) | 208 (74.0) |
| Non-Hispanic Black | 38 (9.1) | 26 (18.4) | 2 (4.4) | 17 (13.5) | 59 (16.8) | 15 (5.3) |
| Hispanic | 111 (26.7) | 25 (17.7) | 22 (48.9) | 30 (23.8) | 104 (29.6) | 41 (14.6) |
| Other | 37 (8.9) | 15 (10.6) | 2 (4.4) | 10 (7.9) | 20 (5.7) | 17 (6.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-pregnancy Body Mass Index (kg/m2) |  |  |  |  |  |  |
| <18.5 | 22 (5.3) | 5 (3.5) | 4 (8.9) | 9 (7.1) | 24 (6.8) | 14 (5.0) |
| 18.5-24.9 | 183 (44.0) | 75 (53.2) | 28 (62.2) | 61 (48.4) | 178 (50.7) | 147 (52.3) |
| 25.0-29.9 | 98 (23.6) | 30 (21.3) | 9 (20.0) | 34 (27.0) | 70 (19.9) | 64 (22.8) |
| ≥30.0 | 113 (27.2) | 31 (22.0) | 4 (8.9) | 22 (17.5) | 79 (22.5) | 56 (19.9) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| Gravidity |  |  |  |  |  |  |
| 0 | 113 (27.2) | 46 (32.6) | 20 (44.4) | 48 (38.1) | 93 (26.5) | 105 (37.4) |
| 1 | 99 (23.8) | 40 (28.4) | 9 (20.0) | 40 (31.7) | 90 (25.6) | 79 (28.1) |
| ≥2 | 204 (49.0) | 55 (39.0) | 16 (35.6) | 38 (30.2) | 168 (47.9) | 97 (34.5) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| Folic acid supplementation b |  |  |  |  |  |  |
| Yes | 362 (87.9) | 125 (89.3) | 36 (81.8) | 106 (85.5) | 292 (83.7) | 254 (91.4) |
| No | 50 (12.1) | 15 (10.7) | 8 (18.2) | 18 (14.5) | 57 (16.3) | 24 (8.6) |
| Missing | 4 | 1 | 1 | 2 | 2 | 3 |
| Pre-pregnancy dietary folate equivalents (µg/day) |  |  |  |  |  |  |
| <600 | 323 (77.6) | 112 (79.4) | 33 (73.3) | 85 (67.5) | 240 (68.4) | 205 (73.0) |
| ≥600 | 93 (22.4) | 29 (20.6) | 12 (26.7) | 41 (32.5) | 111 (31.6) | 76 (27.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-pregnancy total energy intake (calories/day) |  |  |  |  |  |  |
| Low | 153 (36.8) | 65 (46.1) | 16 (35.6) | 45 (35.7) | 114 (32.5) | 114 (40.6) |
| Middle | 138 (33.2) | 42 (29.8) | 12 (26.7) | 44 (34.9) | 100 (28.5) | 87 (31.0) |
| High | 125 (30.0) | 34 (24.1) | 17 (37.8) | 37 (29.4) | 137 (39.0) | 80 (28.5) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |
| Alcohol consumption b |  |  |  |  |  |  |
| No drinking | 251 (61.1) | 80 (58.0) | 25 (55.6) | 77 (61.6) | 231 (66.6) | 156 (55.9) |
| Drinking with no binge episodes | 98 (23.8) | 39 (28.3) | 8 (17.8) | 32 (25.6) | 76 (21.9) | 86 (30.8) |
| Drinking and ≥ 1 binge episode | 62 (15.1) | 19 (13.8) | 12 (26.7) | 16 (12.8) | 40 (11.5) | 37 (13.3) |
| Missing | 5 | 3 | 0 | 1 | 4 | 2 |
| Tobacco smoking exposure b |  |  |  |  |  |  |
| No active and passive smoking | 267 (64.2) | 93 (67.4) | 22 (51.2) | 87 (69.0) | 226 (64.8) | 205 (73.2) |
| Active smoking only | 34 (8.2) | 9 (6.5) | 4 (9.3) | 10 (7.9) | 35 (10.0) | 18 (6.4) |
| Passive smoking only | 61 (14.7) | 22 (15.9) | 6 (14.0) | 15 (11.9) | 44 (12.6) | 32 (11.4) |
| Active and passive smoking | 54 (13.0) | 14 (10.1) | 11 (25.6) | 14 (11.1) | 44 (12.6) | 25 (8.9) |
| Missing | 0 | 3 | 2 | 0 | 2 | 1 |
| NBDPS site |  |  |  |  |  |  |
| Arkansas | 74 (17.8) | 11 (7.8) | 5 (11.1) | 12 (9.5) | 37 (10.5) | 35 (12.5) |
| California | 65 (15.6) | 20 (14.2) | 12 (26.7) | 23 (18.3) | 60 (17.1) | 29 (10.3) |
| CDC/Georgia | 37 (8.9) | 22 (15.6) | 4 (8.9) | 13 (10.3) | 45 (12.8) | 35 (12.5) |
| Iowa | 30 (7.2) | 10 (7.1) | 3 (6.7) | 11 (8.7) | 29 (8.3) | 28 (10.0) |
| Massachusetts | 47 (11.3) | 21 (14.9) | 4 (8.9) | 15 (11.9) | 39 (11.1) | 44 (15.7) |
| New Jersey | 37 (8.9) | 4 (2.8) | 2 (4.4) | 7 (5.6) | 31 (8.8) | 23 (8.2) |
| New York | 31 (7.5) | 14 (9.9) | 3 (6.7) | 7 (5.6) | 28 (8.0) | 28 (10.0) |
| North Carolina | 22 (5.3) | 14 (9.9) | 4 (8.9) | 16 (12.7) | 23 (6.6) | 19 (6.8) |
| Texas | 48 (11.5) | 11 (7.8) | 4 (8.9) | 15 (11.9) | 32 (9.1) | 15 (5.3) |
| Utah | 25 (6.0) | 14 (9.9) | 4 (8.9) | 7 (5.6) | 27 (7.7) | 25 (8.9) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 |

NBDPS: National Birth Defects Prevention Study.

a Due to rounding, proportions may not total to 100.

b During the period one month before [B1] through the third month following [M3] conception.

**Table A.5.** Distributions of child and maternal characteristics among

cases with genitourinary defects, National Birth Defects Prevention

Study, 1997-2011

|  |  |  |  |
| --- | --- | --- | --- |
|  | Bilateral renal agenesis or hypoplasia | Bladder exstrophy | Hypospadias second/third degree |
| Characteristic | N (%) a | N (%) a | N (%) a |
| *Child* |  |  |  |
| Sex |  |  |  |
| Male | 67 (59.3) | 32 (65.3) | 2,066 (100.0) |
| Female | 46 (40.7) | 17 (34.7) | 0 (0.0) |
| Missing | 6 | 0 | 0 |
| Plurality |  |  |  |
| 1 | 112 (94.1) | 48 (98.0) | 1,909 (92.4) |
| 2+ | 7 (5.9) | 1 (2.0) | 157 (7.6) |
| Missing | 0 | 0 | 0 |
| First-degree family history of birth defect |  |  |  |
| Yes | 2 (1.7) | 0 (0.0) | 110 (5.3) |
| No | 117 (98.3) | 49 (100.0) | 1,956 (94.7) |
| Missing | 0 | 0 | 0 |
| *Maternal* |  |  |  |
| Age at delivery (years) |  |  |  |
| <20 | 11 (9.2) | 2 (4.1) | 126 (6.1) |
| 20-24 | 28 (23.5) | 11 (22.4) | 352 (17.0) |
| 25-29 | 40 (33.6) | 14 (28.6) | 543 (26.3) |
| 30-34 | 26 (21.8) | 12 (24.5) | 634 (30.7) |
| 35-39 | 10 (8.4) | 9 (18.4) | 339 (16.4) |
| ≥40 | 4 (3.4) | 1 (2.0) | 72 (3.5) |
| Missing | 0 | 0 | 0 |
| Education at delivery (years) |  |  |  |
| 0-8 | 7 (5.9) | 2 (4.1) | 23 (1.1) |
| 9-11 | 16 (13.4) | 5 (10.2) | 114 (5.6) |
| 12 | 35 (29.4) | 13 (26.5) | 401 (19.5) |
| 13-15 | 39 (32.8) | 11 (22.4) | 570 (27.8) |
| ≥16 | 22 (18.5) | 18 (36.7) | 946 (46.1) |
| Missing | 0 | 0 | 12 |
| Race/ethnicity |  |  |  |
| Non-Hispanic White | 68 (57.1) | 39 (79.6) | 1,551 (75.1) |
| Non-Hispanic Black | 8 (6.7) | 2 (4.1) | 230 (11.1) |
| Hispanic | 35 (29.4) | 5 (10.2) | 155 (7.5) |
| Other | 8 (6.7) | 3 (6.1) | 130 (6.3) |
| Missing | 0 | 0 | 0 |
| Pre-pregnancy Body Mass Index (kg/m2) |  |  |  |
| <18.5 | 7 (5.9) | 4 (8.2) | 100 (4.8) |
| 18.5-24.9 | 54 (45.4) | 29 (59.2) | 1,113 (53.9) |
| 25.0-29.9 | 24 (20.2) | 9 (18.4) | 462 (22.4) |
| ≥30.0 | 34 (28.6) | 7 (14.3) | 391 (18.9) |
| Missing | 0 | 0 | 0 |
| Gravidity |  |  |  |
| 0 | 40 (33.6) | 9 (18.4) | 748 (36.2) |
| 1 | 24 (20.2) | 16 (32.7) | 570 (27.6) |
| ≥2 | 55 (46.2) | 24 (49.0) | 747 (36.2) |
| Missing | 0 | 0 | 1 |
| Folic acid supplementation b |  |  |  |
| Yes | 99 (84.6) | 45 (91.8) | 1,920 (93.8) |
| No | 18 (15.4) | 4 (8.2) | 128 (6.3) |
| Missing | 2 | 0 | 18 |
| Pre-pregnancy dietary folate equivalents (µg/day) |  |  |  |
| <600 | 92 (77.3) | 39 (79.6) | 1,552 (75.1) |
| ≥600 | 27 (22.7) | 10 (20.4) | 514 (24.9) |
| Missing | 0 | 0 | 0 |
| Pre-pregnancy total energy intake (calories/day) |  |  |  |
| Low | 40 (33.6) | 23 (46.9) | 794 (38.4) |
| Middle | 31 (26.1) | 13 (26.5) | 732 (35.4) |
| High | 48 (40.3) | 13 (26.5) | 540 (26.1) |
| Missing | 0 | 0 | 0 |
| Alcohol consumption b |  |  |  |
| No drinking | 79 (66.9) | 28 (57.1) | 1,156 (56.8) |
| Drinking with no binge episodes | 25 (21.2) | 14 (28.6) | 628 (30.9) |
| Drinking and ≥ 1 binge episode | 14 (11.9) | 7 (14.3) | 250 (12.3) |
| Missing | 1 | 0 | 32 |
| Tobacco smoking exposure b |  |  |  |
| No active and passive smoking | 58 (51.3) | 27 (55.1) | 1,506 (73.5) |
| Active smoking only | 12 (10.6) | 8 (16.3) | 129 (6.3) |
| Passive smoking only | 21 (18.6) | 5 (10.2) | 207 (10.1) |
| Active and passive smoking | 22 (19.5) | 9 (18.4) | 207 (10.1) |
| Missing | 6 | 0 | 17 |
| NBDPS site |  |  |  |
| Arkansas | 21 (17.6) | 4 (8.2) | 302 (14.6) |
| California | 22 (18.5) | 5 (10.2) | 95 (4.6) |
| CDC/Georgia | 9 (7.6) | 3 (6.1) | 223 (10.8) |
| Iowa | 12 (10.1) | 10 (20.4) | 167 (8.1) |
| Massachusetts | 5 (4.2) | 13 (26.5) | 423 (20.5) |
| New Jersey | 2 (1.7) | 7 (14.3) | 265 (12.8) |
| New York | 11 (9.2) | 3 (6.1) | 149 (7.2) |
| North Carolina | 7 (5.9) | 1 (2.0) | 205 (9.9) |
| Texas | 18 (15.1) | 0 (0.0) | 29 (1.4) |
| Utah | 12 (10.1) | 3 (6.1) | 208 (10.1) |
| Missing | 0 | 0 | 0 |

NBDPS: National Birth Defects Prevention Study.

a Due to rounding, proportions may not total to 100.

b During the period one month before [B1] through the third month following

[M3] conception.

**Table A.6.** Distributions of child and maternal characteristics among cases with musculoskeletal defects, National Birth Defects Prevention Study, 1997-2011

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cloacal exstrophy | Craniosynostosis | Diaphragmatic hernia | Gastroschisis | Omphalocele | Intercalary limb deficiency | Longitudinal limb deficiency | Transverse limb deficiency | Sacral agenesis or caudal dysplasia |
| Characteristic | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a | N (%) a |
| *Child* |  |  |  |  |  |  |  |  |  |
| Sex |  |  |  |  |  |  |  |  |  |
| Male | 15 (34.1) | 895 (68.2) | 360 (61.4) | 569 (50.2) | 131 (57.7) | 19 (52.8) | 134 (59.6) | 286 (53.3) | 4 (40.0) |
| Female | 29 (65.9) | 418 (31.8) | 226 (38.6) | 564 (49.8) | 96 (42.3) | 17 (47.2) | 91 (40.4) | 251 (46.7) | 6 (60.0) |
| Missing | 4 | 1 | 0 | 3 | 2 | 0 | 0 | 0 | 0 |
| Plurality |  |  |  |  |  |  |  |  |  |
| 1 | 41 (85.4) | 1247 (94.9) | 559 (95.4) | 1,113 (98.0) | 212 (92.6) | 32 (88.9) | 212 (94.2) | 506 (94.2) | 9 (90.0) |
| 2+ | 7 (14.6) | 67 (5.1) | 27 (4.6) | 23 (2.0) | 17 (7.4) | 4 (11.1) | 13 (5.8) | 31 (5.8) | 1 (10.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| First-degree family history of birth defect |  |  |  |  |  |  |  |  |  |
| Yes | 0 (0.0) | 49 (3.7) | 5 (0.9) | 12 (1.1) | 2 (0.9) | 0 (0.0) | 4 (1.8) | 8 (1.5) | 0 (0.0) |
| No | 48 (100.0) | 1265 (96.3) | 581 (99.1) | 1,124 (98.9) | 227 (99.1) | 36 (100.0) | 221 (98.2) | 529 (98.5) | 10 (100.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Maternal* |  |  |  |  |  |  |  |  |  |
| Age at delivery (years) |  |  |  |  |  |  |  |  |  |
| <20 | 7 (14.6) | 63 (4.8) | 43 (7.3) | 382 (33.6) | 18 (7.9) | 5 (13.9) | 25 (11.1) | 52 (9.7) | 2 (20.0) |
| 20-24 | 8 (16.7) | 208 (15.8) | 130 (22.2) | 492 (43.3) | 55 (24.0) | 10 (27.8) | 55 (24.4) | 122 (22.7) | 4 (40.0) |
| 25-29 | 11 (22.9) | 380 (28.9) | 163 (27.8) | 186 (16.4) | 52 (22.7) | 8 (22.2) | 62 (27.6) | 149 (27.7) | 1 (10.0) |
| 30-34 | 14 (29.2) | 397 (30.2) | 154 (26.3) | 62 (5.5) | 52 (22.7) | 7 (19.4) | 53 (23.6) | 146 (27.2) | 2 (20.0) |
| 35-39 | 7 (14.6) | 223 (17.0) | 87 (14.8) | 14 (1.2) | 42 (18.3) | 5 (13.9) | 24 (10.7) | 57 (10.6) | 1 (10.0) |
| ≥40 | 1 (2.1) | 43 (3.3) | 9 (1.5) | 0 (0.0) | 10 (4.4) | 1 (2.8) | 6 (2.7) | 11 (2.0) | 0 (0.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Education at delivery (years) |  |  |  |  |  |  |  |  |  |
| 0-8 | 2 (4.2) | 32 (2.4) | 19 (3.3) | 40 (3.6) | 5 (2.2) | 1 (2.8) | 7 (3.2) | 17 (3.2) | 0 (0.0) |
| 9-11 | 8 (16.7) | 96 (7.3) | 45 (7.8) | 258 (23.1) | 19 (8.3) | 4 (11.1) | 22 (10.0) | 54 (10.1) | 4 (40.0) |
| 12 | 8 (16.7) | 276 (21.1) | 141 (24.4) | 429 (38.4) | 61 (26.8) | 8 (22.2) | 56 (25.3) | 144 (27.0) | 3 (30.0) |
| 13-15 | 17 (35.4) | 383 (29.2) | 167 (28.8) | 301 (26.9) | 69 (30.3) | 14 (38.9) | 64 (29.0) | 156 (29.3) | 2 (20.0) |
| ≥16 | 13 (27.1) | 524 (40.0) | 207 (35.8) | 90 (8.1) | 74 (32.5) | 9 (25.0) | 72 (32.6) | 162 (30.4) | 1 (10.0) |
| Missing | 0 | 3 | 7 | 18 | 1 | 0 | 4 | 4 | 0 |
| Race/ethnicity |  |  |  |  |  |  |  |  |  |
| Non-Hispanic White | 32 (66.7) | 993 (75.6) | 375 (64.0) | 603 (53.1) | 141 (61.6) | 22 (61.1) | 140 (62.2) | 319 (59.4) | 6 (60.0) |
| Non-Hispanic Black | 7 (14.6) | 42 (3.2) | 40 (6.8) | 91 (8.0) | 35 (15.3) | 5 (13.9) | 28 (12.4) | 42 (7.8) | 0 (0.0) |
| Hispanic | 8 (16.7) | 214 (16.3) | 130 (22.2) | 351 (30.9) | 39 (17.0) | 7 (19.4) | 43 (19.1) | 146 (27.2) | 3 (30.0) |
| Other | 1 (2.1) | 65 (4.9) | 41 (7.0) | 91 (8.0) | 14 (6.1) | 2 (5.6) | 14 (6.2) | 30 (5.6) | 1 (10.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-pregnancy Body Mass Index (kg/m2) |  |  |  |  |  |  |  |  |  |
| <18.5 | 5 (10.4) | 66 (5.0) | 27 (4.6) | 108 (9.5) | 9 (3.9) | 2 (5.6) | 6 (2.7) | 30 (5.6) | 0 (0.0) |
| 18.5-24.9 | 22 (45.8) | 650 (49.5) | 326 (55.6) | 766 (67.4) | 108 (47.2) | 25 (69.4) | 120 (53.3) | 273 (50.8) | 6 (60.0) |
| 25.0-29.9 | 10 (20.8) | 329 (25.0) | 127 (21.7) | 201 (17.7) | 58 (25.3) | 5 (13.9) | 64 (28.4) | 133 (24.8) | 2 (20.0) |
| ≥30.0 | 11 (22.9) | 269 (20.5) | 106 (18.1) | 61 (5.4) | 54 (23.6) | 4 (11.1) | 35 (15.6) | 101 (18.8) | 2 (20.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gravidity |  |  |  |  |  |  |  |  |  |
| 0 | 13 (27.1) | 339 (25.8) | 183 (31.2) | 547 (48.2) | 77 (33.6) | 16 (44.4) | 67 (29.8) | 180 (33.5) | 5 (50.0) |
| 1 | 12 (25.0) | 380 (28.9) | 150 (25.6) | 318 (28.0) | 63 (27.5) | 5 (13.9) | 76 (33.8) | 147 (27.4) | 0 (0.0) |
| ≥2 | 23 (47.9) | 594 (45.2) | 253 (43.2) | 271 (23.9) | 89 (38.9) | 15 (41.7) | 82 (36.4) | 210 (39.1) | 5 (50.0) |
| Missing | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Folic acid supplementation b |  |  |  |  |  |  |  |  |  |
| Yes | 42 (87.5) | 1181 (91.5) | 514 (88.9) | 947 (84.3) | 203 (89.4) | 33 (91.7) | 204 (91.5) | 471 (89.0) | 7 (70.0) |
| No | 6 (12.5) | 110 (8.5) | 64 (11.1) | 176 (15.7) | 24 (10.6) | 3 (8.3) | 19 (8.5) | 58 (11.0) | 3 (30.0) |
| Missing | 0 | 23 | 8 | 13 | 2 | 0 | 2 | 8 | 0 |
| Pre-pregnancy dietary folate equivalents (µg/day) |  |  |  |  |  |  |  |  |  |
| <600 | 31 (64.6) | 995 (75.7) | 436 (74.4) | 792 (69.7) | 160 (69.9) | 25 (69.4) | 163 (72.4) | 398 (74.1) | 7 (70.0) |
| ≥600 | 17 (35.4) | 319 (24.3) | 150 (25.6) | 344 (30.3) | 69 (30.1) | 11 (30.6) | 62 (27.6) | 139 (25.9) | 3 (30.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-pregnancy total energy intake (calories/day) |  |  |  |  |  |  |  |  |  |
| Low | 17 (35.4) | 486 (37.0) | 222 (37.9) | 393 (34.6) | 74 (32.3) | 8 (22.2) | 77 (34.2) | 186 (34.6) | 3 (30.0) |
| Middle | 12 (25.0) | 478 (36.4) | 199 (34.0) | 362 (31.9) | 86 (37.6) | 18 (50.0) | 64 (28.4) | 187 (34.8) | 4 (40.0) |
| High | 19 (39.6) | 350 (26.6) | 165 (28.2) | 381 (33.5) | 69 (30.1) | 10 (27.8) | 84 (37.3) | 164 (30.5) | 3 (30.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alcohol consumption b |  |  |  |  |  |  |  |  |  |
| No drinking | 28 (58.3) | 834 (63.9) | 368 (63.2) | 640 (57.5) | 127 (55.7) | 25 (69.4) | 137 (61.2) | 337 (63.5) | 9 (90.0) |
| Drinking with no binge episodes | 14 (29.2) | 310 (23.8) | 140 (24.1) | 223 (20.0) | 65 (28.5) | 6 (16.7) | 54 (24.1) | 117 (22.0) | 1 (10.0) |
| Drinking and ≥ 1 binge episode | 6 (12.5) | 161 (12.3) | 74 (12.7) | 251 (22.5) | 36 (15.8) | 5 (13.9) | 33 (14.7) | 77 (14.5) | 0 (0.0) |
| Missing | 0 | 9 | 4 | 22 | 1 | 0 | 1 | 6 | 0 |
| Tobacco smoking exposure b |  |  |  |  |  |  |  |  |  |
| No active and passive smoking | 33 (75.0) | 950 (72.8) | 385 (66.6) | 511 (46.0) | 149 (66.5) | 27 (75.0) | 138 (61.9) | 345 (65.1) | 4 (40.0) |
| Active smoking only | 3 (6.8) | 96 (7.4) | 54 (9.3) | 139 (12.5) | 19 (8.5) | 3 (8.3) | 19 (8.5) | 59 (11.1) | 1 (10.0) |
| Passive smoking only | 4 (9.1) | 132 (10.1) | 77 (13.3) | 200 (18.0) | 28 (12.5) | 2 (5.6) | 30 (13.5) | 71 (13.4) | 4 (40.0) |
| Active and passive smoking | 4 (9.1) | 127 (9.7) | 62 (10.7) | 262 (23.6) | 28 (12.5) | 4 (11.1) | 36 (16.1) | 55 (10.4) | 1 (10.0) |
| Missing | 4 | 9 | 8 | 24 | 5 | 0 | 2 | 7 | 0 |
| NBDPS site |  |  |  |  |  |  |  |  |  |
| Arkansas | 2 (4.2) | 164 (12.5) | 71 (12.1) | 165 (14.5) | 28 (12.2) | 7 (19.4) | 41 (18.2) | 37 (6.9) | 1 (10.0) |
| California | 5 (10.4) | 119 (9.1) | 67 (11.4) | 235 (20.7) | 23 (10.0) | 2 (5.6) | 22 (9.8) | 71 (13.2) | 3 (30.0) |
| CDC/Georgia | 3 (6.3) | 81 (6.2) | 78 (13.3) | 105 (9.2) | 25 (10.9) | 1 (2.8) | 23 (10.2) | 52 (9.7) | 0 (0.0) |
| Iowa | 6 (12.5) | 146 (11.1) | 58 (9.9) | 109 (9.6) | 22 (9.6) | 6 (16.7) | 26 (11.6) | 45 (8.4) | 1 (10.0) |
| Massachusetts | 7 (14.6) | 186 (14.2) | 84 (14.3) | 95 (8.4) | 30 (13.1) | 2 (5.6) | 35 (15.6) | 65 (12.1) | 2 (20.0) |
| New Jersey | 5 (10.4) | 41 (3.1) | 31 (5.3) | 40 (3.5) | 17 (7.4) | 4 (11.1) | 10 (4.4) | 46 (8.6) | 0 (0.0) |
| New York | 4 (8.3) | 80 (6.1) | 43 (7.3) | 65 (5.7) | 23 (10.0) | 0 (0.0) | 18 (8.0) | 45 (8.4) | 3 (30.0) |
| North Carolina | 3 (6.3) | 132 (10.0) | 32 (5.5) | 86 (7.6) | 18 (7.9) | 4 (11.1) | 12 (5.3) | 42 (7.8) | 0 (0.0) |
| Texas | 6 (12.5) | 80 (6.1) | 59 (10.1) | 119 (10.5) | 22 (9.6) | 4 (11.1) | 20 (8.9) | 61 (11.4) | 0 (0.0) |
| Utah | 7 (14.6) | 285 (21.7) | 63 (10.8) | 117 (10.3) | 21 (9.2) | 6 (16.7) | 18 (8.0) | 73 (13.6) | 0 (0.0) |
| Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NBDPS: National Birth Defects Prevention Study.

a Due to rounding, proportions may not total to 100.

b During the period one month before [B1] through the third month following [M3] conception.

**Table A.7.** Odds ratios and 95% confidence intervals for associations between maternal arsenic exposure in diet (μg/kg-bw/day) and selected

isolated non-cardiac birth defects among mothers without pre-pregnancy diabetes, National Birth Defects Prevention Study (NBDPS), 1997-2011

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total Arsenic | | Inorganic Arsenic | |
|  | Middle vs. Low | High vs. Low | Middle vs. Low | High vs. Low |
| Birth defect | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| *Central Nervous* |  |  |  |  |
| Anencephaly | 0.9 (0.7, 1.1) a | 0.8 (0.6, 1.0) a | 0.9 (0.7, 1.1) b | 0.8 (0.7, 1.0) b |
| Encephalocele | 1.1 (0.7, 1.8) a | 1.5 (1.0, 2.3) a | 1.1 (0.7, 1.7) c | 1.1 (0.7, 1.7) c |
| Spina bifida | 0.9 (0.8, 1.1) a | 0.8 (0.7, 1.0) a | 0.9 (0.8, 1.0) a | 0.7 (0.6, 0.9) a |
| Cerebellar hypoplasia | 0.9 (0.4, 2.0) d,e | 0.6 (0.2, 1.5) d,e | 0.9 (0.4, 2.2) d,f | 1.2 (0.4, 3.2) d,f |
| Dandy-Walker malformation | 1.0 (0.6, 1.6) b | 0.5 (0.3, 0.9) b | 1.0 (0.6, 1.6) a | 0.4 (0.2, 0.7) a |
| Holoprosencephaly | 0.9 (0.6, 1.5) b | 0.5 (0.3, 0.9) b | 0.7 (0.4, 1.2) b | 0.9 (0.5, 1.4) b |
| Hydrocephalus | 0.9 (0.7, 1.3) a | 1.1 (0.8, 1.4) a | 1.0 (0.8, 1.4) a | 1.0 (0.8, 1.4) a |
| *Ear* |  |  |  |  |
| Anotia/microtia | 1.0 (0.7, 1.3) a | 1.1 (0.9, 1.4) a | 0.8 (0.7, 1.1) g | 0.8 (0.6, 1.1) g |
| *Eye* |  |  |  |  |
| Anopthalmos/micropthalmos | 1.2 (0.7, 1.8) a | 1.1 (0.7, 1.6) a | 1.0 (0.6, 1.5) c | 0.9 (0.6, 1.5) c |
| Cataracts | 1.0 (0.7, 1.4) c | 1.3 (0.9, 1.8) c | 1.2 (0.9, 1.6) c | 1.2 (0.8, 1.6) c |
| Glaucoma/anterior chamber defects | 1.1 (0.7, 1.8) a | 1.1 (0.7, 1.8) a | 0.9 (0.6, 1.5) c | 1.5 (0.9, 2.4) c |
| *Craniofacial* |  |  |  |  |
| Choanal atresia | 0.5 (0.3, 0.9) h | 0.5 (0.3, 0.9) h | 1.0 (0.5, 1.7) i | 1.1 (0.6, 2.1) i |
| Cleft lip w/wo cleft palate | 0.9 (0.8, 1.0) a | 0.8 (0.7, 0.9) a | 1.0 (0.9, 1.1) a | 0.9 (0.8, 1.1) a |
| Cleft palate | 0.8 (0.7, 0.9) a | 0.9 (0.7, 1.0) a | 1.0 (0.9, 1.2) a | 0.9 (0.8, 1.1) a |
| *Gastrointestinal* |  |  |  |  |
| Anorectal atresia/stenosis | 0.8 (0.6, 1.0) a | 0.8 (0.6, 1.0) a | 0.9 (0.7, 1.1) j | 0.9 (0.7, 1.1) j |
| Biliary atresia | 1.0 (0.7, 1.5) k | 0.9 (0.6, 1.4) k | 1.1 (0.7, 1.6) l | 1.0 (0.6, 1.5) l |
| Colonic atresia/stenosis | 0.5 (0.2, 1.1) d,m | 0.6 (0.3, 1.3) d,m | 1.7 (0.8, 3.7) d,n | 1.4 (0.7, 3.2) d,n |
| Duodenal atresia/stenosis | 0.9 (0.6, 1.4) a | 0.8 (0.5, 1.2) a | 1.1 (0.7, 1.7) a | 0.9 (0,6, 1.4) a |
| Intestinal atresia/stenosis | 1.2 (0.9, 1.5) a | 1.1 (0.9, 1.5) a | 1.0 (0.8, 1.3) a | 1.2 (0.9, 1.6) a |
| Esophageal atresia | 0.9 (0.7, 1.2) o | 1.0 (0.7, 1.3) o | 1.2 (0.9, 1.7) c | 1.3 (0.9, 1.8) c |
| *Genitourinary* |  |  |  |  |
| Bilateral renal agenesis or hypoplasia | 1.2 (0.8, 1.9) d | 0.9 (0.5, 1.5) d | 1.5 (1.0, 2.4) p | 1.2 (0.7, 2.0) p |
| Bladder exstrophy | 0.7 (0.3, 1.4) d,q | 1.1 (0.5, 2.2) d,q | 1.3 (0.6, 2.6) d,r | 1.0 (0.4, 2.3) d,r |
| Hypospadias second/third degree | 0.8 (0.7, 0.9) o | 0.7 (0.6, 0.8) o | 1.2 (1.0, 1.3) k | 1.3 (1.1, 1.5) k |
| *Musculoskeletal* |  |  |  |  |
| Cloacal exstrophy | 3.7 (1.4, 10.0) s | 3.5 (1.3, 9.6) s | 1.2 (0.6, 2.5) t | 1.5 (0.7, 3.1) t |
| Craniosynostosis | 0.9 (0.8, 1.0) u | 0.7 (0.6, 0.8) u | 1.0 (0.9, 1.1) c | 0.9 (0.7, 1.0) c |
| Diaphragmatic hernia | 1.1 (0.9, 1.3) a | 0.8 (0.7, 1.0) a | 0.9 (0.7, 1.1) c | 1.0 (0.8, 1.3) c |
| Gastroschisis | 1.0 (0.9, 1.2) m | 0.8 (0.7, 1.0) m | 1.3 (1.1, 1.5) n | 1.3 (1.1, 1.6) n |
| Omphalocele | 1.1 (0.8, 1.5) a | 0.9 (0.7, 1.3) a | 0.8 (0.6, 1.1) a | 0.8 (0.6, 1.1) a |
| Intercalary limb deficiency | 1.1 (0.5, 2.5) d,v | 1.3 (0.6, 3.0) d,v | 2.5 (1.1, 5.9) d,v | 1.0 (0.4, 2.8) d,v |
| Longitudinal limb deficiency | 1.0 (0.7, 1.3) a | 0.8 (0.6, 1.2) a | 0.9 (0.6, 1.3) a | 1.1 (0.8, 1.5) a |
| Transverse limb deficiency | 0.9 (0.7, 1.1) a | 0.8 (0.6, 0.9) a | 1.2 (1.0, 1.5) v | 1.1 (0.9, 1.4) v |
| Sacral agenesis or caudal dysplasia | NC | NC | NC | NC |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; OR: odds ratio; CI: Confidence interval; NC: not calculated.

a crude estimate.

b Adjusted for maternal race/ethnicity.

c Adjusted for total pre-pregnancy energy intake.

d Firth’s logistic regression used.

e Adjusted for maternal tobacco smoking exposure one month before conception (B1) through third month after conception (M3), and NBDPS site.

f Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, tobacco smoking exposure (B1-M3), and NBDPS site.

g Adjusted for maternal race/ethnicity and NBDPS site.

h Adjusted for maternal age at delivery.

i Adjusted for maternal age at delivery, race/ethnicity, education at delivery, pre-pregnancy dietary folate equivalents, total pre-pregnancy energy intake, and

NBDPS site.

j Adjusted for maternal pre-pregnancy dietary folate equivalents.

k Adjusted for maternal race/ethnicity and total pre-pregnancy energy intake.

l Adjusted for maternal pre-pregnancy dietary folate equivalents and total pre-pregnancy energy intake.

m Adjusted for maternal age and education at delivery, and tobacco smoking exposure (B1-M3).

n Adjusted for maternal age and education at delivery, race/ethnicity, and tobacco smoking exposure (B1-M3).

o Adjusted for maternal age at delivery and NBDPS site.

p Adjusted for pre-pregnancy dietary folate equivalents, and NBDPS site.

q Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, and NBDPS site.

r Adjusted for maternal pre-pregnancy dietary folate equivalents, total pre-pregnancy energy intake, tobacco smoking exposure (B1-M3), and NBDPS site.

s Adjusted for child sex and maternal tobacco smoking exposure (B1-M3).

t Adjusted for maternal race/ethnicity and NBDPS site.

u Adjusted for maternal age at delivery, race/ethnicity, and NBDPS site.

v Adjusted for NBDPS site.

**Table A.8.** Odds ratios and 95% confidence intervals for associations between maternal arsenic exposure in diet (μg/kg-bw/day) and selected

isolated non-cardiac birth defects among singleton pregnancies, National Birth Defects Prevention Study (NBDPS), 1997-2011

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total Arsenic | | Inorganic Arsenic | |
|  | Middle vs. Low | High vs. Low | Middle vs. Low | High vs. Low |
| Birth defect | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| *Central Nervous* |  |  |  |  |
| Anencephaly | 0.9 (0.7, 1.1) a | 0.8 (0.6, 1.0) a | 0.8 (0.7, 1.1) b | 0.8 (0.7, 1.1) b |
| Encephalocele | 1.1 (0.7, 1.6) c | 1.4 (0.9, 2.1) c | 1.2 (0.8, 1.8) d | 1.1 (0.7, 1.7) d |
| Spina bifida | 0.9 (0.8, 1.1) c | 0.8 (0.7, 1.0) c | 0.9 (0.8, 1.1) c | 0.7 (0.6, 0.9) c |
| Cerebellar hypoplasia | 0.8 (0.4, 2.0) e | 0.5 (0.2, 1.4) e | 1.0 (0.4, 2.4) f,g | 1.1 (0.4, 2.7) f,g |
| Dandy-Walker malformation | 0.9 (0.5, 1.4) h | 0.5 (0.3, 0.8) h | 1.1 (0.7, 1.8) h | 0.4 (0.2, 0.8) h |
| Holoprosencephaly | 1. (0.6, 1.5) h | 0.4 (0.2, 0.8) h | 0.7 (0.4, 1.1) h | 0.9 (0.5, 1.4) h |
| Hydrocephalus | 0.9 (0.7, 1.2) c | 1.1 (0.8, 1.4) c | 1.0 (0.7, 1.3) c | 1.0 (0.7, 1.3) c |
| *Ear* |  |  |  |  |
| Anotia/microtia | 1.0 (0.7, 1.2) c | 1.2 (0.9, 1.5) c | 0.9 (0.7, 1.1) b | 0.8 (0.7, 1.1) b |
| *Eye* |  |  |  |  |
| Anopthalmos/micropthalmos | 1.2 (0.7, 1.8) c | 1.0 (0.6, 1.5) c | 1.0 (0.6, 1.5) d | 0.9 (0.6, 1.5) d |
| Cataracts | 0.9 (0.6, 1.2) c | 1.1 (0.8, 1.5) c | 1.1 (0.8, 1.5) d | 1.2 (0.8, 1.6) d |
| Glaucoma/anterior chamber defects | 1.2 (0.7, 1.9) c | 1.1 (0.7, 1.7) c | 0.9 (0.5, 1.5) d | 1.3 (0.8, 2.1) d |
| *Craniofacial* |  |  |  |  |
| Choanal atresia | 0.5 (0.3, 0.9) i | 0.5 (0.3, 0.9) i | 1.0 (0.5, 1.8) j | 1.1 (0.6, 2.1) j |
| Cleft lip w/wo cleft palate | 0.8 (0.8, 0.9) c | 0.8 (0.7, 0.8) c | 1.0 (0.9, 1.1) c | 0.9 (0.8, 1.0) c |
| Cleft palate | 0.8 (0.7, 0.9) c | 0.9 (0.8, 1.0) c | 1.0 (0.9, 1.2) c | 0.9 (0.8, 1.1) c |
| *Gastrointestinal* |  |  |  |  |
| Anorectal atresia/stenosis | 0.8 (0.6, 1.0) c | 0.7 (0.6, 0.9) c | 0.8 (0.6, 1.0) c | 0.8 (0.6, 1.0) c |
| Biliary atresia | 1.1 (0.7, 1.6) k | 1.0 (0.6, 1.5) k | 1.0 (0.7, 1.6) l | 0.9 (0.5, 1.4) l |
| Colonic atresia/stenosis | 0.4 (0.2, 1.0) f,m | 0.6 (0.3, 1.3) f,m | 1.6 (0.7, 3.5) f,n | 1.4 (0.7, 3.2) f,n |
| Duodenal atresia/stenosis | 0.9 (0.6, 1.4) c | 0.8 (0.5, 1.2) c | 1.1 (0.7, 1.7) c | 0.9 (0.6, 1.4) c |
| Intestinal atresia/stenosis | 1.2 (0.9, 1.5) a | 1.0 (0.8, 1.4) a | 1.0 (0.7, 1.3) c | 1.2 (0.9, 1.6) c |
| Esophageal atresia | 0.9 (0.6, 1.2) i | 1.1 (0.8, 1.4) i | 1.2 (0.9, 1.6) d | 1.2 (0.8, 1.7) d |
| *Genitourinary* |  |  |  |  |
| Bilateral renal agenesis or hypoplasia | 1.1 (0.7, 1.7) o | 0.9 (0.6, 1.5) o | 1.3 (0.8, 2.1) p | 1.2 (0.7, 2.0) p |
| Bladder exstrophy | 0.7 (0.3, 1.4) f,q | 1.2 (0.6, 2.4) f,q | 1.1 (0.5, 2.1) f,r | 0.9 (0.4, 2.0) f,r |
| Hypospadias second/third degree | 0.8 (0.7, 0.9) s | 0.7 (0.6, 0.8) s | 1.2 (1.0, 1.3) t | 1.2 (1.1, 1.4) t |
| *Musculoskeletal* |  |  |  |  |
| Cloacal exstrophy | 6.0 (1.8, 20.4) u | 4.7 (1.3, 16.6) u | 1.3 (0.6, 3.0) v | 1.6 (0.7, 3.6) v |
| Craniosynostosis | 0.9 (0.8, 1.0) w | 0.7 (0.6, 0.8) w | 1.0 (0.9, 1.2) d | 0.9 (0.7, 1.0) d |
| Diaphragmatic hernia | 1.1 (0.9, 1.3) c | 0.8 (0.7, 1.0) c | 0.9 (0.7, 1.1) d | 1.0 (0.8, 1.3) d |
| Gastroschisis | 1.0 (0.9, 1.2) n | 0.8 (0.7, 1.0) n | 1.3 (1.1, 1.5) n | 1.4 (1.1, 1.6) n |
| Omphalocele | 1.1 (0.8, 1.5) c | 0.9 (0.7, 1.3) c | 0.8 (0.5, 1.1) c | 0.9 (0.6, 1.2) c |
| Intercalary limb deficiency | 1.0 (0.4, 2.2) f,a | 1.2 (0.5, 2.7) f,a | 2.3 (1.0, 5.8) f,k | 1.2 (0.4, 3.4) f,k |
| Longitudinal limb deficiency | 0.9 (0.6, 1.2) c | 0.7 (0.5, 1.0) c | 0.9 (0.6, 1.2) c | 1.1 (0.8, 1.5) c |
| Transverse limb deficiency | 0.9 (0.7, 1.1) c | 0.7 (0.6, 0.9) c | 1.2 (1.0, 1.5) k | 1.1 (0.9, 1.4) k |
| Sacral agenesis or caudal dysplasia | NC | NC | NC | NC |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; OR: odds ratio; CI: Confidence interval; NC: not calculated.

a Adjusted for NBDPS site.

b Adjusted for maternal race/ethnicity and NBDPS site.

c Crude estimate.

d Adjusted for total pre-pregnancy energy intake.

e Adjusted for maternal tobacco smoking exposure one month before conception (B1) through third month after conception (M3).

f Firth’s logistic regression used.

g Adjusted for maternal race/ethnicity, tobacco smoking exposure (B1-M3), and NBDPS site.

h Adjusted for maternal race/ethnicity.

i Adjusted for maternal age at delivery.

j Adjusted for maternal age at delivery, race/ethnicity, pre-pregnancy dietary folate equivalents, total pre-pregnancy energy intake, and NBDPS site.

k Adjusted for maternal total pre-pregnancy energy intake and NBDPS site.

l Adjusted for maternal pre-pregnancy dietary folate equivalents, total pre-pregnancy energy intake, and NBDPS site.

m Adjusted for maternal age and education at delivery.

n Adjusted formaternal race/ethnicity, age and education at delivery, and tobacco smoking exposure (B1-M3).

o Adjusted for maternal tobacco smoking exposure (B1-M3), and NBDPS site.

p Adjusted for maternal pre-pregnancy dietary folate equivalents and NBDPS site.

q Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, NBDPS site.

r Adjusted for maternal pre-pregnancy dietary folate equivalents, total pre-pregnancy energy intake, tobacco smoking exposure (B1-M3), and NBDPS site.

s Adjusted for maternal age at delivery and NBDPS site.

t Adjusted for maternal race/ethnicity and total pre-pregnancy energy intake.

u Adjusted for child sex, maternal tobacco smoking exposure (B1-M3), and NBDPS site.

v Adjusted for child sex and maternal race/ethnicity.

w Adjusted for maternal age at delivery, race/ethnicity, and NBDPS site.

**Table A.9.** Odds ratios and 95% confidence intervals for associations between maternal arsenic exposure in diet (μg/kg-bw/day) and selected

isolated non-cardiac birth defects among folate-deficient mothers, National Birth Defects Prevention Study (NBDPS), 1997-2011

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total Arsenic | | Inorganic Arsenic | |
|  | Middle vs. Low | High vs. Low | Middle vs. Low | High vs. Low |
| Birth defect | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| *Central Nervous* |  |  |  |  |
| Anencephaly | 1.1 (0.7, 1.6) a | 1.0 (0.7, 1.5) a | 0.8 (0.5, 1.2) b | 0.6 (0.4, 0.9) b |
| Encephalocele | 1.1 (0.5, 2.5) c | 1.6 (0.7, 3.6) c | 2.5 (1.0, 5.9) d | 2.5 (1.0, 6.1) d |
| Spina bifida | 0.8 (0.6, 1.1) e | 0.9 (0.7, 1.2) e | 1.1 (0.8, 1.5) e | 0.9 (0.7, 1.3) e |
| Cerebellar hypoplasia | NC | NC | NC | NC |
| Dandy-Walker malformation | NC | NC | NC | NC |
| Holoprosencephaly | NC | NC | NC | 1.1 (0.2, 5.6) f,g |
| Hydrocephalus | 1.4 (0.4, 4.8) g,h | 1.6 (0.5, 5.4) g,h | 1.0 (0.3, 3.1) g,i | 0.8 (0.2, 2.5) g,i |
| *Ear* |  |  |  |  |
| Anotia/microtia | 1.7 (0.7, 4.1) g,j | 2.5 (1.1, 5.9) g,j | 1.0 (0.4, 2.2) k | 1.4 (0.6, 3.1) k |
| *Eye* |  |  |  |  |
| Anopthalmos/micropthalmos | NC | NC | NC | NC |
| Cataracts | NC | 1.0 (0.3, 2.7) g,l | NC | NC |
| Glaucoma/anterior chamber defects | NC | NC | NC | NC |
| *Craniofacial* |  |  |  |  |
| Choanal atresia | NC | NC | NC | NC |
| Cleft lip w/wo cleft palate | 1.0 (0.7, 1.4) e | 1.0 (0.7, 1.4) e | 1.0 (0.7, 1.5) b | 0.8 (0.5, 1.2) b |
| Cleft palate | 0.9 (0.5, 1.7) m | 1.1 (0.6, 1.9) m | 0.9 (0.5, 1.5) e | 0.8 (0.5, 1.5) e |
| *Gastrointestinal* |  |  |  |  |
| Anorectal atresia/stenosis | 0.7 (0.3, 1.5) g,n | 1.0 (0.5, 2.3) g,n | 0.7 (0.3, 1.6) o | 0.6 (0.2, 1.3) o |
| Biliary atresia | NC | NC | NC | NC |
| Colonic atresia/stenosis | NC | NC | NC | NC |
| Duodenal atresia/stenosis | NC | 0.8 (0.2, 2.8) g,p | NC | NC |
| Intestinal atresia/stenosis | NC | NC | 0.7 (0.2, 1.8) g,q | 1.4 (0.6, 3.5) g,q |
| Esophageal atresia | NC | NC | NC | NC |
| *Genitourinary* |  |  |  |  |
| Bilateral renal agenesis or hypoplasia | NC | NC | NC | NC |
| Bladder exstrophy | NC | NC | NC | NC |
| Hypospadias second/third degree | 0.8 (0.4, 1.5) r | 1.2 (0.6, 2.3) r | 1.7 (0.9, 3.0) s | 1.3 (0.7, 2.5) s |
| *Musculoskeletal* |  |  |  |  |
| Cloacal exstrophy | NC | NC | NC | NC |
| Craniosynostosis | 1.2 (0.7, 2.1) t | 1.1 (0.6, 2.2) t | 0.6 (0.3, 1.2) u | 1.3 (0.7, 2.3) u |
| Diaphragmatic hernia | 2.0 (0.9, 4.8) v | 1.8 (0.8, 4.4) v | 0.8 (0.4, 1.8) v | 0.9 (0.4, 2.2) v |
| Gastroschisis | 1.0 (0.6, 1.7) g,w | 1.1 (0.7, 1.8) g,w | 1.5 (0.8, 2.6) g,x | 2.3 (1.3, 4.1) g,x |
| Omphalocele | 0.7 (0.2, 2.2) g,t | NC | 0.9 (0.2, 2.9) g,y | 0.9 (0.3, 3.3) g,y |
| Intercalary limb deficiency | NC | NC | NC | NC |
| Longitudinal limb deficiency | NC | NC | NC | NC |
| Transverse limb deficiency | 0.8 (0.4, 2.0) e | 1.6 (0.8, 3.3) e | 0.6 (0.2 1.4) z | 1.1 (0.5, 2.4) z |
| Sacral agenesis or caudal dysplasia | NC | NC | NC | NC |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; OR: odds ratio; CI: Confidence interval; NC: not calculated.

a Adjusted for child sex.

b Adjusted for maternal race/ethnicity.

c Adjusted for maternal race/ethnicity and total pre-pregnancy energy intake.

d Adjusted for maternal total pre-pregnancy energy intake.

e crude estimate.

f Adjusted for maternal age at delivery, race/ethnicity, gravidity, total pre-pregnancy energy intake, tobacco smoking exposure one month before conception

(B1) through third month after conception (M3), and NBDPS site.

g Firth’s logistic regression used.

h Adjusted gravidity, maternal total pre-pregnancy energy intake, and NBDPS site.

i Adjusted for maternal age at delivery, total pre-pregnancy energy intake, and alcohol consumption (B1-M3).

j Adjusted for maternal education at delivery, tobacco smoking exposure (B1-M3), and NBDPS site.

k Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, and tobacco smoking exposure (B1-M3).

l Adjusted for maternal education at delivery and NBDPS site.

m Adjusted for maternal age at delivery and race/ethnicity.

n Adjusted for maternal education at delivery and NBDPS site.

o Adjusted for maternal education at delivery.

p Adjusted for maternal age and education at delivery, total pre-pregnancy energy intake, and NBDPS site.

q Adjusted for plurality, maternal age at delivery and NBDPS site.

r Adjusted for maternal education at delivery, total pre-pregnancy energy intake, and NBDPS site.

s Adjusted for maternal race/ethnicity and total pre-pregnancy energy intake.

t Adjusted for maternal age at delivery, race/ethnicity, total pre-pregnancy energy intake, and NBDPS site.

u Adjusted for maternal age at delivery, total pre-pregnancy energy intake and NBDPS site.

v Adjusted for maternal education at delivery and total pre-pregnancy energy intake.

w Adjusted for maternal age at delivery.

x Adjusted for maternal age and education at delivery, race/ethnicity, total pre-pregnancy energy intake, and tobacco smoking exposure (B1-M3).

y Adjusted for maternal age at delivery, total pre-pregnancy energy intake, tobacco smoking exposure (B1-M3).

z Adjusted for maternal total pre-pregnancy energy intake and tobacco smoking exposure (B1-M3).

**Table A.10.** Selected odds ratios and 95% confidence intervals by maternal smoking status for associations between maternal total   
arsenic exposure in diet (μg/kg-bw/day) and selected isolated non-cardiac birth defects, National Birth Defects Prevention Study   
(NBDPS), 1997-2011

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | RERI (95% CI) | |  | Within smoking strata  OR (95% CI) | |  | Smoking and total arsenic exposure  OR (95% CI) | | |
| Birth defect | Middle vs. low tertile | High vs. low tertile |  | Middle vs. low tertile | High vs. low tertile |  | Low Tertile | Middle Tertile | High Tertile |
| *Central Nervous* |  |  |  |  |  |  |  |  |  |
| Anencephaly a | 0.5 (0.1, 0.9) | 0.4 (0.1, 0.7) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.8 (0.6, 1.0) | 0.7 (0.5, 0.9) |  | ref | 0.8 (0.6, 1.0) | 0.7 (0.5, 0.9) |
| Smoking |  |  |  | 1.5 (1.0, 2.2) | 1.2 (0.8, 1.9) |  | 0.6 (0.4, 0.8) | 0.8 (0.6, 1.2) | 0.7 (0.5, 1.0) |
| Dandy-Walker malformation b | 0.5 (-0.3, 1.3) | 0.7 (0.05, 1.2) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.8 (0.5, 1.4) | 0.4 (0.2, 0.8) |  | ref | 0.8 (0.5, 1.4) | 0.4 (0.2, 0.8) |
| Smoking |  |  |  | 1.6 (0.7, 4.0) | 1.2 (0.5, 3.1) |  | 0.6 (0.2, 1.2) | 0.9 (0.4, 1.8) | 0.7 (0.3, 1.4) |
| *Ear* a |  |  |  |  |  |  |  |  |  |
| Anotia/microtia | 0.3 (-0.2, 0.7) | 0.7 (0.2, 1.1) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.9 (0.6, 1.2) | 0.9 (0.7, 1.2) |  | ref | 0.9 (0.6, 1.2) | 0.9 (0.7, 1.2) |
| Smoking |  |  |  | 1.2 (0.8, 2.1) | 2.0 (1.2, 3.1) |  | 0.6 (0.4, 0.9) | 0.7 (0.5, 1.1) | 1.2 (0.8, 1.7) |
| *Eye* a |  |  |  |  |  |  |  |  |  |
| Anopthalmos/ micropthalmos | 0.6 (-0.3, 1.4) | 0.9 (0.02, 1.8) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.9 (0.6, 1.2) | 1.0 (0.7, 1.3) |  | ref | 0.9 (0.6, 1.6) | 0.8 (0.4, 1.3) |
| Smoking |  |  |  | 1.9 (0.8, 4.2) | 2.1 (0.9, 4.6) |  | 0.6 (0.3, 1.3) | 1.2 (0.6, 2.2) | 1.3 (0.7, 2.4) |
| *Craniofacial* |  |  |  |  |  |  |  |  |  |
| Cleft palate a | 0.1 (-0.2, 0.4) | 0.4 (0.1, 0.7) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.8 (0.6, 0.9) | 0.8 (0.6, 0.9) |  | ref | 0.8 (0.6, 0.9) | 0.8 (0.6, 0.9) |
| Smoking |  |  |  | 0.9 (0.7, 1.1) | 1.1 (0.9, 1.4) |  | 1.0 (0.9, 1.3) | 0.9 (0.7, 1.2) | 1.2 (0.9, 1.5) |
| *Gastrointestinal* |  |  |  |  |  |  |  |  |  |
| Intestinal atresia/stenosis a | 0.7 (0.1, 1.2) | 0.6 (0.1, 1.2) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.9 (0.7, 1.3) | 0.9 (0.7, 1.3) |  | ref | 0.9 (0.7, 1.3) | 0.9 (0.7, 1.3) |
| Smoking |  |  |  | 1.8 (1.1, 2.8) | 1.7 (1.1, 2.7) |  | 0.8 (0.5, 1.2) | 1.4 (1.0, 2.0) | 1.3 (0.9, 2.0) |
| *Musculoskeletal* |  |  |  |  |  |  |  |  |  |
| Omphalocele a | -1.1 (-2.5, -0.2) | -0.2 (-1.3, 0.6) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 1.5 (1.0, 2.2) | 1.1 (0.7, 1.7) |  | ref | 1.5 (1.0, 2.2) | 1.1 (0.7, 1.7) |
| Smoking |  |  |  | 0.6 (0.3, 1.1) | 0.9 (0.5, 1.6) |  | 1.6 (1.0, 2.5) | 1.0 (0.6, 1.7) | 1.5 (0.9, 2.4) |
| Transverse limb deficiency a | 0.4 (-0.05, 0.7) | 0.4 (0.01, 0.8) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.8 (0.6, 1.0) | 0.6 (0.5, 0.8) |  | ref | 0.8 (0.6, 1.0) | 0.6 (0.5, 0.8) |
| Smoking |  |  |  | 1.1 (0.8, 1.6) | 1.1 (0.7, 1.5) |  | 0.9 (0.7, 1.2) | 1.0 (0.7, 1.4) | 0.9 (0.7, 1.3) |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; RERI: relative excess risk due to interaction; CI: Confidence interval; OR: odds ratio.

a Crude estimate.

b Adjusted for maternal race/ethnicity.

c Adjusted for maternal race/ethnicity, pre-pregnancy energy intake, NBDPS site.

d Firths logistic regression used.

**Table A.11.** Selected odds ratios and 95% confidence intervals by maternal smoking status for associations between maternal inorganic

arsenic exposure in diet (μg/kg-bw/day) and selected isolated non-cardiac birth defects, National Birth Defects Prevention Study (NBDPS),

1997-2011

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | RERI (95% CI) | |  | Within smoking strata  OR (95% CI) | |  | Smoking and inorganic arsenic exposure  OR (95% CI) | | |
| Birth defect | Middle vs. low tertile | High vs. low tertile |  | Middle vs. low tertile | High vs. low tertile |  | Low Tertile | Middle Tertile | High Tertile |
| *Craniofacial* |  |  |  |  |  |  |  |  |  |
| Cleft palate a | 0.4 (0.1, 0.7) | 0.5 (0.2, 0.8) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.9 (0.8, 1.1) | 0.8 (0.7, 1.0) |  | ref | 0.9 (0.8, 1.1) | 0.8 (0.7, 1.0) |
| Smoking |  |  |  | 1.3 (1.0, 1.7) | 1.3 (1.0, 1.7) |  | 0.9 (0.8, 1.2) | 1.3 (1.0, 1.6) | 1.3 (1.0, 1.6) |
| *Musculoskeletal* |  |  |  |  |  |  |  |  |  |
| Diaphragmatic hernia b | 0.3 (-0.1, 0.7) | 0.5 (0.04, 0.9) |  |  |  |  |  |  |  |
| No smoking |  |  |  | 0.8 (0.6, 1.0) | 0.9 (0.7, 1.2) |  | ref | 0.8 (0.6, 1.0) | 0.9 (0.7, 1.2) |
| Smoking |  |  |  | 1.1 (0.7, 1.5) | 1.4 (1.0, 2.0) |  | 0.9 (0.7, 1.2) | 0.9 (0.7, 1.3) | 1.2 (0.9, 1.7) |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; RERI: relative excess risk due to interaction; CI: Confidence interval; OR: odds ratio.

a Crude estimate.

b Adjusted for pre-pregnancy energy intake.

**Table A.12.** Odds ratios and 95% confidence intervals for associations between high-dose

maternal arsenic exposure in diet (μg/kg-bw/day) and selected isolated non-cardiac birth

defects, National Birth Defects Prevention Study (NBDPS), 1997-2011

|  |  |  |
| --- | --- | --- |
|  | Total Arsenic | Inorganic Arsenic |
|  | ≥90th percentile | ≥90th percentile |
| Birth defect | OR (95% CI) | OR (95% CI) |
| *Central Nervous* |  |  |
| Anencephaly | 0.8 (0.6, 1.1) a | 0.6 (0.5, 0.9) b |
| Encephalocele | 1.2 (0.7, 2.1) a | 0.9 (0.5, 1.6) b |
| Spina bifida | 0.9 (0.7, 1.1) a | 0.9 (0.7, 1.1) a |
| Cerebellar hypoplasia | NC | NC |
| Dandy-Walker malformation | 0.8 (0.4, 1.5) b | NC |
| Holoprosencephaly | NC | 0.7 (0.3, 1.4) c |
| Hydrocephalus | 1.0 (0.7, 1.4) a | 0.9 (0.6, 1.4) b |
| *Ear* |  |  |
| Anotia/microtia | 1.1 (0.8, 1.5) a | 0.8 (0.6, 1.1) d |
| *Eye* |  |  |
| Anopthalmos/micropthalmos | 0.5 (0.2, 1.1) a | 1.0 (0.6, 1.9) a |
| Cataracts | 0.9 (0.6, 1.4) a | 0.9 (0.6, 1.5) e |
| Glaucoma/anterior chamber defects | 0.8 (0.4, 1.5) a | 1.1 (0.6, 1.9) f |
| *Craniofacial* |  |  |
| Choanal atresia | 1.1 (0.5, 2.4) g | 1.6 (0.7, 3.7) h |
| Cleft lip w/wo cleft palate | 0.9 (0.8, 1.0) a | 0.8 (0.7, 0.9) a |
| Cleft palate | 0.9 (0.7, 1.1) a | 1.0 (0.8, 1.2) a |
| *Gastrointestinal* |  |  |
| Anorectal atresia/stenosis | 1.0 (0.7, 1.4) a | 0.7 (0.5, 1.0) i |
| Biliary atresia | 0.8 (0.5, 1.6) j | 1.0 (0.5, 1.8) h |
| Colonic atresia/stenosis | NC | NC |
| Duodenal atresia/stenosis | 0.5 (0.3, 1.2) k | 1.4 (0.8, 2.5) e |
| Intestinal atresia/stenosis | 1.0 (0.7, 1.4) a | 1.3 (0.9, 1.7) l |
| Esophageal atresia | 0.9 (0.6, 1.4) b | 0.8 (0.5, 1.3) m |
| *Genitourinary* |  |  |
| Bilateral renal agenesis or hypoplasia | 0.8 (0.4, 1.5) n | 0.6 (0.3, 1.3) h |
| Bladder exstrophy | 1.1 (0.4, 2.6) o,p | NC |
| Hypospadias second/third degree | 1.0 (0.8, 1.1) a | 1.2 (1.0, 1.5) h |
| *Musculoskeletal* |  |  |
| Craniosynostosis | 0.9 (0.7, 1.1) b | 0.8 (0.6, 1.0) m |
| Diaphragmatic hernia | 0.8 (0.6, 1.1) a | 0.9 (0.6, 1.2) e |
| Gastroschisis | 0.8 (0.6, 1.0) q | 1.2 (1.0, 1.5) b |
| Omphalocele | 1.0 (0.6, 1.5) a | 1.0 (0.6, 1.5) a |
| Cloacal exstrophy | NC | 1.2 (0.5, 3.1) r |
| Sacral agenesis or caudal dysplasia | NC | NC |
| Intercalary limb deficiency | 1.8 (0.6, 4.2) o,l | NC |
| Longitudinal limb deficiency | 0.9 (0.6, 1.5) a | 0.8 (0.5, 1.3) a |
| Transverse limb deficiency | 0.9 (0.7, 1.3) a | 1.0 (0.8, 1.4) a |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; OR: odds ratio; CI: Confidence interval; NC: not

calculated.

a Crude estimate.

b Adjusted for maternal race/ethnicity.

c Adjusted for maternal race/ethnicity and folic acid supplementation.

d Adjusted for maternal race/ethnicity and NBDPS site.

e Adjusted for total pre-pregnancy energy intake.

f Adjusted for maternal alcohol consumption one month before conception (B1) through third month

after conception (M3).

g Adjusted for maternal age at delivery and race/ethnicity.

h Adjusted for maternal race/ethnicity, pre-pregnancy dietary folate equivalents, and total pre-pregnancy

energy intake.

i Adjusted for maternal race/ethnicity, pre-pregnancy dietary folate equivalents, and NBDPS site.

j Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, and tobacco smoking

exposure (B1-M3).

k Adjusted for folic acid supplementation.

l Adjusted for NBDPS site.

m Adjusted for maternal race/ethnicity and total pre-pregnancy energy intake.

n Adjusted for child sex.

o Firth’s logistic regression used.

p Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, and NBDPS site.

q Adjusted for maternal age at delivery.

r Adjusted for maternal race/ethnicity, tobacco smoking exposure (B1-M3), and NBDPS site.

**Table A.13** Odds ratios and 95% confidence intervals for associations between total arsenic   
exposure in diet (μg/kg-bw/day) and selected isolated non-cardiac birth defects using

maximum values reported in the Total Diet Study, National Birth Defects Prevention Study

(NBDPS), 1997-2011.

|  |  |  |
| --- | --- | --- |
|  | Total Arsenic | |
|  | Middle vs. Low | High vs. Low |
| Birth defect | OR (95% CI) | OR (95% CI) |
| *Central Nervous* |  |  |
| Anencephaly | 0.9 (0.7, 1.1)a | 0.8 (0.7, 1.0)a |
| Encephalocele | 1.3 (0.8, 2.0)b | 1.6 (1.0, 2.4)b |
| Spina bifida | 0.9 (0.8, 1.1)a | 0.9 (0.7, 1.0)a |
| Cerebellar hypoplasia | 0.7 (0.3, 1.6)c,d | 0.4 (0.1, 1.1)c,d |
| Dandy-Walker malformation | 0.7 (0.4, 1.1)e | 0.5 (0.3, 0.8)e |
| Holoprosencephaly | 0.8 (0.5, 1.3)e | 0.5 (0.3, 0.9)e |
| Hydrocephalus | 0.9 (0.7, 1.2)a | 1.1 (0.8, 1.4)a |
| *Ear* |  |  |
| Anotia/microtia | 1.0 (0.8, 1.3)a | 1.2 (0.9, 1.5)a |
| *Eye* |  |  |
| Anopthalmos/micropthalmos | 0.9 (0.6, 1.4)a | 0.9 (0.6, 1.4)a |
| Cataracts | 0.7 (0.5, 1.0)a | 1.0 (0.8, 1.4)a |
| Glaucoma/anterior chamber defects | 1.1 (0.7, 1.7)a | 1.2 (0.8, 1.9)a |
| *Craniofacial* |  |  |
| Choanal atresia | 0.9 (0.6, 1.6)f | 0.6 (0.3, 1.1)f |
| Cleft lip w/wo cleft palate | 0.9 (0.8, 1.0)a | 0.8 (0.7, 0.9)a |
| Cleft palate | 0.8 (0.7, 1.0)a | 0.9 (0.8, 1.0)a |
| *Gastrointestinal* |  |  |
| Anorectal atresia/stenosis | 0.7 (0.5, 0.9)g | 0.7 (0.5, 0.9)g |
| Biliary atresia | 1.1 (0.7, 1.7)b | 1.0 (0.7, 1.6)b |
| Colonic atresia/stenosis | 0.8 (0.4, 1.5)c,h | 0.7 (0.3, 1.4)c,h |
| Duodenal atresia/stenosis | 0.8 (0.5, 1.2)a | 0.7 (0.5, 1.1) a |
| Intestinal atresia/stenosis | 1.0 (0.7, 1.3)g | 1.0 (0.8, 1.3)g |
| Esophageal atresia | 0.7 (0.5, 1.0)i | 0.9 (0.6, 1.2)i |
| *Genitourinary* |  |  |
| Bilateral renal agenesis or hypoplasia | 0.8 (0.5, 1.3)j | 0.8 (0.5, 1.2)j |
| Bladder exstrophy | 0.9 (0.4, 1.9)c,k | 1.4 (0.7, 2.8)c,k |
| Hypospadias second/third degree | 0.8 (0.7, 0.9)g | 0.7 (0.6, 0.8)g |
| *Musculoskeletal* |  |  |
| Cloacal exstrophy | 3.6 (1.3, 9.7)l | 3.7 (1.4, 10.0)l |
| Craniosynostosis | 0.8 (0.7, 0.9)m | 0.7 (0.6, 0.9)m |
| Diaphragmatic hernia | 1.1 (0.9, 1.3)a | 0.8 (0.7, 1.0)a |
| Gastroschisis | 0.9 (0.8, 1.1)h | 0.9 (0.7, 1.0)h |
| Omphalocele | 1.1 (0.8, 1.5)a | 1.0 (0.8, 1.4)a |
| Intercalary limb deficiency | 1.2 (0.5, 2.8)c,g | 1.8 (0.8, 4.1)c,g |
| Longitudinal limb deficiency | 0.8 (0.6, 1.1)a | 0.7 (0.5, 1.0)a |
| Transverse limb deficiency | 0.9 (0.7, 1.1)a | 0.8 (0.6, 1.0)a |
| Sacral agenesis or caudal dysplasia | NC | NC |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; OR: odds ratio; CI: Confidence interval; NC: not   
calculated.

a Crude estimate.

b Adjusted for total pre-pregnancy energy intake.

c Firth’s logistic regression used.

d Adjusted for tobacco smoking exposure (B1-M3) and NBDPS site.

e Adjusted for maternal race/ethnicity.

f Adjusted for maternal age at delivery.

g Adjusted for NBDPS site.

h Adjusted for maternal age and education at delivery, and tobacco smoking exposure (B1-M3).

i Adjusted for maternal age at delivery and NBDPS site.

j Adjusted for tobacco smoking exposure (B1-M3).

k Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, and NBDPS site.

l Adjusted for child sex and maternal tobacco smoking exposure (B1-M3).

m Adjusted for maternal race/ethnicity and age at delivery, and NBDPS site.

**Table A.14.** Odds ratios and 95% confidence intervals for associations between maternal arsenic

exposure in diet including cereal consumption (μg/kg-bw/day) and selected isolated

non-cardiac birth defects, National Birth Defects Prevention Study (NBDPS), 1997-2011

|  |  |  |
| --- | --- | --- |
|  | Total Arsenic | |
|  | Middle vs. Low | High vs. Low |
| Birth defect | OR (95% CI) | OR (95% CI) |
| *Central Nervous* |  |  |
| Anencephaly | 0.9 (0.7, 1.1) a | 0.8 (0.6, 1.0) a |
| Encephalocele | 1.1 (0.7, 1.7) a | 1.3 (0.9, 2.0) a |
| Spina bifida | 0.9 (0.8, 1.1) a | 0.8 (0.7, 1.0) a |
| Cerebellar hypoplasia | 0.8 (0.3, 1.8) b,c | 0.5 (0.2, 1.2) b,c |
| Dandy-Walker malformation | 1.0 (0.6, 1.6) d | 0.5 (0.3, 0.9) d |
| Holoprosencephaly | 0.9 (0.6, 1.4) d | 0.4 (0.3, 0.8) d |
| Hydrocephalus | 0.9 (0.7, 1.2) a | 1.1 (0.8, 1.5) a |
| *Ear* |  |  |
| Anotia/microtia | 1.1 (0.8, 1.4) a | 1.3 (1.0, 1.6) a |
| *Eye* |  |  |
| Anopthalmos/micropthalmos | 1.1 (0.7, 1.7) a | 1.0 (0.6, 1.6) a |
| Cataracts | 0.9 (0.7, 1.2) e | 1.2 (0.9, 1.7) e |
| Glaucoma/anterior chamber defects | 1.2 (0.7, 1.9) f | 1.3 (0.8, 2.1) f |
| *Craniofacial* |  |  |
| Choanal atresia | 0.5 (0.3, 0.9) g | 0.6 (0.3, 1.0) g |
| Cleft lip w/wo cleft palate | 0.9 (0.8, 1.0) a | 0.8 (0.7, 0.9) a |
| Cleft palate | 0.8 (0.7, 0.9) a | 0.9 (0.8, 1.0) a |
| *Gastrointestinal* |  |  |
| Anorectal atresia/stenosis | 0.7 (0.6, 0.9) a | 0.7 (0.6, 0.9) a |
| Biliary atresia | 1.0 (0.6, 1.5) h | 1.0 (0.7, 1.5) h |
| Colonic atresia/stenosis | 0.5 (0.2, 1.1) b,i | 0.6 (0.3, 1.3) b,i |
| Duodenal atresia/stenosis | 0.9 (0.6, 1.4) a | 0.7 (0.4, 1.1) a |
| Intestinal atresia/stenosis | 1.1 (0.8, 1.4) a | 1.2 (0.9, 1.5) a |
| Esophageal atresia | 0.9 (0.7, 1.3) h | 1.2 (0.9, 1.6) h |
| *Genitourinary* |  |  |
| Bilateral renal agenesis or hypoplasia | 1.0 (0.7, 1.6) c | 0.9 (0.5, 1.4) c |
| Bladder exstrophy | 1.1 (0.5, 2.3) b,j | 1.2 (0.6, 2.6) b,j |
| Hypospadias second/third degree | 0.8 (0.7, 0.9) k | 0.7 (0.6, 0.8) k |
| *Musculoskeletal* |  |  |
| Cloacal exstrophy | 3.0 (1.2, 7.5) l | 3.2 (1.3, 8.0) l |
| Craniosynostosis | 0.9 (0.8, 1.0) m | 0.7 (0.6, 0.8) m |
| Diaphragmatic hernia | 1.1 (0.9, 1.3) a | 0.9 (0.7, 1.1) a |
| Gastroschisis | 1.0 (0.8, 1.2) i | 0.9 (0.7, 1.0) i |
| Omphalocele | 1.0 (0.8, 1.4) a | 0.9 (0.7, 1.3) a |
| Intercalary limb deficiency | 1.1 (0.5, 2.7) b,n | 1.5 (0.6, 3.5) b,n |
| Longitudinal limb deficiency | 0.9 (0.7, 1.2) a | 0.8 (0.6, 1.1) a |
| Transverse limb deficiency | 0.9 (0.7, 1.1) a | 0.8 (0.6, 1.0) a |
| Sacral agenesis or caudal dysplasia | NC | NC |

μg/kg-bw/day: micrograms/kilogram-bodyweight/day; OR: odds ratio; CI: Confidence interval;

NC: not calculated.

a Crude estimate.

b Firth’s logistic regression used.

c Adjusted for maternal tobacco smoking exposure one month before conception (B1) through third

month after conception (M3), and NBDPS site.

d Adjusted for maternal race/ethnicity.

e Adjusted for total pre-pregnancy energy intake.

f Adjusted for maternal alcohol consumption (B1-M3).

g Adjusted for maternal age at delivery

h Adjusted for maternal age at delivery and race/ethnicity

i Adjusted for maternal age and education at delivery, and tobacco smoking exposure (B1-M3).

j Adjusted for maternal race/ethnicity, total pre-pregnancy energy intake, and NBDPS site.

k Adjusted for maternal age at delivery and NBDPS site

l Adjusted for child sex.

m Adjusted for maternal age at delivery, race/ethnicity, and NBDPS site.

n Adjusted for NBDPS site.