**Supplementary Appendix**

**Hypothesis 1: Individuals who live in areas with more fast food outlets have a higher risk of overweight/obesity**

**Table A1: Results from two Structural Equation Models analysing the association between count of fast food outlets and risk of overweight/obesity in waves 5 and 6 of Millennium Cohort Study.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Odds Ratio** | **Lower CI** | **Upper CI** | **p value** | **n** |
| **Model 1: LSOA** | |  |  |  |  |  |
| Outcome | Wave 6 Overweight/obesity |  |  |  |  | 8619 |
|  | Wave 6 fast food outlets | 0.9927 | 0.9642 | 1.0220 | 0.622 |  |
|  | Wave 5 Overweight/obesity | 31.385 | 27.551 | 35.752 | <0.001 |  |
| Outcome | Wave 5 Overweight/obesity |  |  |  |  | 7101 |
|  | Wave 5 fast food outlets | 1.0137 | 0.9851 | 1.0406 | 0.310 |  |
| Outcome | Wave 6 fast food outlets |  |  |  |  | 7159 |
|  | Wave 5 fast food outlets | 1.2213 | 1.2169 | 1.2257 | <0.001 |  |
| **Model 2: Local Authority** | |  |  |  |  |  |
| Outcome | Wave 6 Overweight/obesity |  |  |  |  | 8619 |
|  | Wave 6 fast food outlets | 1.00049 | 1.00015 | 1.00083 | <0.001 |  |
|  | Wave 5 Overweight/obesity | 31.233 | 27.416 | 35.582 | <0.001 |  |
| Outcome | Wave 5 Overweight/obesity |  |  |  |  | 7101 |
|  | Wave 5 fast food outlets | 1.00059 | 1.00023 | 1.00091 | <0.001 |  |
| Outcome | Wave 6 fast food outlets |  |  |  |  | 7159 |
|  | Wave 5 fast food outlets | 1.00322 | 1.00321 | 1.00323 | <0.001 |  |

Model 1 fit n = 9224, AIC = 36340.46, BIC = 36390.37; Model 2 fit: n = 9224, AIC = 317750.8, BIC 317800.7

Regression models varied by outcome. Overweight/obesity was modelled as binomial logit. Fast food outlets as was modelled using a Poisson regression (selected due to the distribution of the variable which was positively skewed representing a count model distribution). Use of linear models or alternative count models did not alter the findings.

**Hypothesis 2: Individual's who live in deprived areas have a higher risk of overweight/obesity.**

**Table A2: Results from two Structural Equation Models analysing the association between IMD quintile and risk of overweight/obesity in waves 5 and 6 of Millennium Cohort Study.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Odds Ratio** | **Lower CI** | **Upper CI** | **p value** | **n** |
| Outcome | Wave 6 Overweight/obesity |  |  |  |  | 9058 |
|  | Wave 6 IMD Quintile 1 | 1.40565 | 1.15582 | 1.70949 | 0.001 |  |
|  | Wave 6 IMD Quintile 2 | 1.36378 | 1.11046 | 1.67488 | 0.003 |  |
|  | Wave 6 IMD Quintile 3 | 1.17721 | 0.95490 | 1.45129 | 0.127 |  |
|  | Wave 6 IMD Quintile 4 | 1.11518 | 0.90042 | 1.38117 | 0.318 |  |
|  | Wave 6 IMD Quintile 5 | Reference |  |  |  |  |
|  | Wave 5 Overweight/Obesity | 30.456 | 26.817 | 34.589 | <0.001 |  |
| Outcome | Wave 5 Overweight/obesity |  |  |  |  | 9504 |
|  | Wave 5 IMD Quintile 1 | 1.88991 | 1.63525 | 2.18424 | <0.001 |  |
|  | Wave 5 IMD Quintile 2 | 1.66992 | 1.43314 | 1.94583 | <0.001 |  |
|  | Wave 5 IMD Quintile 3 | 1.58153 | 1.35507 | 1.84583 | <0.001 |  |
|  | Wave 5 IMD Quintile 4 | 1.25060 | 1.06645 | 1.46654 | 0.006 |  |
|  | Wave 5 IMD Quintile 5 | Reference |  |  |  |  |
| Outcome | Wave 6 IMD Quintile |  |  |  |  | 9718 |
|  | Wave 5 IMD Quintile 1 | 1.75e-08 | 1.17e-08 | 2.63e-08 | <0.001 |  |
|  | Wave 5 IMD Quintile 2 | 2.92e-06 | 2.07e-06 | 4.11e-06 | <0.001 |  |
|  | Wave 5 IMD Quintile 3 | 0.000155 | 0.000115 | 0.00207 | <0.001 |  |
|  | Wave 5 IMD Quintile 4 | 0.007499 | 0.005910 | 0.00952 | <0.001 |  |
|  | Wave 5 IMD Quintile 5 | Reference |  |  |  |  |

Model fit n=9730AIC = 27432.35, BIC=27568.83.

IMD is modelled as ordinal variable (no different if multinomial), obesity as binomial logit again

Regression models varied by outcome. Neighbourhood deprivation (quintile) was modelled as an ordinal variable. We also tested multinomial regression which produced similar findings. Overweight/obesity was modelled as binomial logit.

**Hypothesis 3: Area deprivation confounds the association between fast food outlets and overweight/obesity.**

**Table A3: Results from two Structural Equation Models analysing the association between count of fast food outlets for Lower Super Output Areas, IMD quintile and risk of overweight/obesity in waves 5 and 6 of Millennium Cohort Study.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Odds Ratio** | **Lower CI** | **Upper CI** | **p value** | **n** |
| Outcome | Wave 6 Overweight/obesity |  |  |  |  | 8613 |
|  | Wave 6 fast food outlets | 0.9807 | 0.95185 | 1.0103 | 0.199 |  |
|  | Wave 5 Overweight/obesity | 30.6741 | 26.9165 | 34.9561 | <0.001 |  |
|  | Wave 6 IMD Quintile 1 | 1.42882 | 1.1623 | 1.75645 | 0.001 |  |
|  | Wave 6 IMD Quintile 2 | 1.38343 | 1.11637 | 1.71436 | 0.003 |  |
|  | Wave 6 IMD Quintile 3 | 1.17145 | 0.9422 | 1.45649 | 0.154 |  |
|  | Wave 6 IMD Quintile 4 | 1.11591 | 0.89452 | 1.39208 | 0.331 |  |
|  | Wave 6 IMD Quintile 5 | Reference |  |  |  |  |
| Outcome | Wave 5 Overweight/obesity |  |  |  |  | 7101 |
|  | Wave 5 fast food outlets | 0.99002 | 0.96343 | 1.01735 | 0.470 |  |
|  | Wave 5 IMD Quintile 1 | 1.94992 | 1.64083 | 2.31723 | <0.001 |  |
|  | Wave 5 IMD Quintile 2 | 1.84176 | 1.54335 | 2.19786 | <0.001 |  |
|  | Wave 5 IMD Quintile 3 | 1.62145 | 1.35747 | 1.93675 | <0.001 |  |
|  | Wave 5 IMD Quintile 4 | 1.31426 | 1.09772 | 1.57352 | 0.003 |  |
|  | Wave 5 IMD Quintile 5 | Reference | |  |  |  |
| Outcome | Wave 5 Fast food outlets |  |  |  |  | 7151 |
|  | Wave 5 IMD Quintile 1 | 3.03133 | 2.80113 | 3.28045 | <0.001 |  |
|  | Wave 5 IMD Quintile 2 | 2.66304 | 2.45445 | 2.88935 | <0.001 |  |
|  | Wave 5 IMD Quintile 3 | 1.82734 | 1.67536 | 1.99311 | <0.001 |  |
|  | Wave 5 IMD Quintile 4 | 1.50715 | 1.37799 | 1.64841 | <0.001 |  |
|  | Wave 5 IMD Quintile 5 | Reference | |  |  |  |
| Outcome | Wave 6 Fast food outlets |  |  |  |  | 7269 |
|  | Wave 6 IMD Quintile 1 | 2.10174 | 1.94664 | 2.692 | <0.001 |  |
|  | Wave 6 IMD Quintile 2 | 2.00574 | 1.85393 | 2.16999 | <0.001 |  |
|  | Wave 6 IMD Quintile 3 | 1.64206 | 1.51272 | 1.78245 | <0.001 |  |
|  | Wave 6 IMD Quintile 4 | 1.36933 | 1.25735 | 1.49128 | <0.001 |  |
|  | Wave 6 IMD Quintile 5 | Reference | |  |  |  |
|  | Wave 5 fast food outlets | 1.20655 | | 1.201975 | 1.211143 | <0.001 |
| Outcome | Wave 6 IMD Quintile |  | |  |  | 9718 |
|  | Wave 5 IMD Quintile 1 | 1.75e-8 | | 1.17e-08 | 2.63e-08 | <0.001 |
|  | Wave 5 IMD Quintile 2 | 2.93e-06 | | 2.07e-06 | 4.11e-06 | <0.001 |
|  | Wave 5 IMD Quintile 3 | 0.0001545 | | 0.000115 | 0.00021 | <0.001 |
|  | Wave 5 IMD Quintile 4 | 0.007499 | | 0.00591 | 0.009515 | <0.001 |
|  | Wave 5 IMD Quintile 5 | Reference | |  |  |  |

Model fit n=9729, AIC = 70879.11, BIC = 71108.96

**Table A4: Results from two Structural Equation Models analysing the association between count of fast food outlets for Local Authorities, IMD quintile and risk of overweight/obesity in waves 5 and 6 of Millennium Cohort Study.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Odds Ratio** | **Lower CI** | | **Upper CI** | | **p value** | | **n** | |
| Outcome | Wave 6 Overweight/obesity |  | |  | |  | |  | | 8613 | |
|  | Wave 6 fast food outlets | 1.00027 | | 0.99989 | | 1.00066 | | 0.162 | |  | |
|  | Wave 5 Overweight/obesity | 30.7162 | | 26.9523 | | 35.0056 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 1.30864 | | 1.04884 | | 1.63278 | | 0.017 | |  | |
|  | Wave 6 IMD Quintile 2 | 1.31831 | | 1.06089 | | 1.63819 | | 0.013 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.1384 | | 0.91482 | | 1.41662 | | 0.245 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.09648 | | 0.878447 | | 1.36863 | | 0.415 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | |  | |  | |  | |  | |
| Outcome | Wave 5 Overweight/obesity |  | |  | |  | |  | | 7101 | |
|  | Wave 5 fast food outlets | 1.0001 | | 0.99975 | | 1.00046 | | 0.578 | |  | |
|  | Wave 5 IMD Quintile 1 | 1.8916 | | 1.57523 | | 2.27144 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 2 | 1.80876 | | 1.51367 | | 2.16136 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 3 | 1.60502 | | 1.34279 | | 1.91846 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 4 | 1.30517 | | 1.0896 | | 1.56334 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 5 | Reference | | | |  | |  | |  | |
| Outcome | Wave 5 Fast food outlets |  | |  | |  | |  | | 7269 | |
|  | Wave 5 IMD Quintile 1 | 2.87045 | | 2.85378 | | 2.88721 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 2 | 1.90054 | | 1.8886 | | 1.91256 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 3 | 1.54127 | | 1.53118 | | 1.55143 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 4 | 1.41461 | | 1.40524 | | 1.42405 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 5 | Reference | | | |  | |  | |  | |
| Outcome | Wave 6 Fast food outlets |  | |  | |  | |  | | 7151 | |
|  | Wave 6 IMD Quintile 1 | 1.3402 | | 1.33224 | | 1.34821 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 1.28188 | | 1.27401 | | 1.28979 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.18506 | | 1.17757 | | 1.19261 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.12679 | | 1.11962 | | 1.133999 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | | | |  | |  | |  | |
|  | Wave 5 fast food outlets | 1.003064 | | | | 1.003057 | | 1.003072 | | <0.001 | |
| Outcome | Wave 6 IMD Quintile |  | | | |  | |  | | 9718 | |
|  | Wave 5 IMD Quintile 1 | 1/75e-08 | | | | 1.17e-08 | | 2.63e-08 | | <0.001 | |
|  | Wave 5 IMD Quintile 2 | 2.92e-06 | | | | 2.07e-06 | | 4.11e-06 | | <0.001 | |
|  | Wave 5 IMD Quintile 3 | 0.001545 | | | | 0.000115 | | 0.000207 | | <0.001 | |
|  | Wave 5 IMD Quintile 4 | 0.007499 | | | | 0.00591 | | 0.009515 | | <0.001 | |
|  | Wave 5 IMD Quintile 5 | Reference | | | |  | |  | |  | |

Model fit n=9729, AIC=1067989, BIC=1068219

In both Tables A3 and A4, overweight was modelled using a logistic regression model, IMD quintile was modelled using an ordinal variable, count of takeaway was modelled using a count (poisson) regression model (this was due to evidence of positive skew in the data). We tested the use of a linear regression model for both LSOAs and LADs, however they resulted in poorer fit and did not alter the associations detected.

We repeated the same analyses as described above but changing the exposures for fast food outlets to:

* Count per population
* Proportion of total outlets that are fast food outlets
* Ratio of fast food outlets to supermarkets
* Convert food environment counts to tertiles (quintiles were not possible for LSOA values)

Results are presented below:

**Table A5: Results from two Structural Equation Models (one at LSOA level and one at LAD level) analysing the association between measures of the food environment and risk of overweight/obesity in waves 5 and 6 of Millennium Cohort Study (adjusting for deprivation).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scale** | **Measure** | **Odds Ratio** | **Lower CI** | | | **Upper CI** | | | | | **p value** | | |
|  | Proportion of all outlets as fast food outlets | | | | | | |  | |  | | |  |
| LSOAs | Wave 6 takeaway | 0.92621 | | | 0.81149 | | 1.05715 | | 0.256 | | | | |
|  | Wave 5 takeaway | 1.00098 | | | 0.82395 | | 1.21605 | | 0.992 | | | | |
| LADs | Wave 6 takeaway | 0.99275 | | | 0.97441 | | 1.01144 | | 0.445 | | | | |
|  | Wave 5 takeaway | 1.83362 | | | 1.09204 | | 3.07881 | | 0.022 | | | | |
|  | Ratio of fast food outlets to supermarkets | | |  | | | |  | |  | | |  |
| LSOAs | Wave 6 ratio | 0.950647 | | | 0.881996 | | 1.02464 | | 0.186 | | | | |
|  | Wave 5 ratio | 1.00092 | | | 0.94794 | | 1.05687 | | 0.974 | | | | |
| LADs | Wave 6 ratio | 0.99388 | | | 0.96959 | | 1.01879 | | 0.627 | | | | |
|  | Wave 5 ratio | 0.998575 | | | 0.99196 | | 1.00524 | | 0.674 | | | | |
|  | Tertiles | | |  | | | |  | |  | | |  |
| LSOAs | Wave 6 tertile 1 (least) | Reference | | | | |  | |  | | | | |  |
|  | Wave 6 tertile 2 | 0.76007 | | | 0.63409  0.74368 | | 0.91108  1.01422 | | 0.003  0.075 | | |
|  | Wave 6 tertile 3 (Most) | 0.86848 | | |
|  | Wave 5 tertile 1 (least) | Reference | | |  | |  | |  | | | | |
|  | Wave 5 tertile 2 | 0.921586 | | | 0.79674 | | 1.06599 | | 0.272 | | | | |
|  | Wave 5 tertile 3 (Most) | 0.99737 | | | 0.87692 | | 1.13437 | | 0.968 | | | | |
| LADs | Wave 6 tertile 1 (least) | Reference | | |  | |  | |  | | | | |
|  | Wave 6 tertile 2 | 0.95516 | | | 0.800338 | | 1.13993 | | 0.611 | | | | |
|  | Wave 6 tertile 3 (Most) | 0.874295 | | | 0.74404 | | 1.02735 | | 0.103 | | | | |
|  | Wave 5 tertile 1 (least) | Reference | | |  | |  | |  | | | | |
|  | Wave 5 tertile 2 | 0.92295 | | | 0.80224 | | 1.06182 | | 0.262 | | | | |
|  | Wave 5 tertile 3 (Most) | 0.96321 | | | 0.84030 | | 1.10400 0.590 | | | | | | |
|  | Count per pop | | |  | | | | | |  | | |  |
| LSOAs | Wave 6 rate | 1.10e-16  0.000048 | | | 5.35e-40  8.95e-25 | | 2.25e+07  2.61e+15 | | 0.180  0.668 | | | | |
|  | Wave 5 rate |
| LADs | Wave 6 rate | 4.00e-47  3.94e+70 | | | 3.5e-152  7.60e-09 | | 4.55e+58  2.0e+149 | | 0.387  0.079 | | | | |
|  | Wave 5 rate |

**Note**: Wave 5 n = 7101, Wave 6 n = 8613.

In all models, logistic regression was used to model overweight.

**Hypothesis 4: Areas where the number of fast food outlets increased, individuals had higher likelihood of being overweight/obese.**

**Table A6:** **Results from two Structural Equation Models (one at LSOA level and one at LAD level) examining the association between change in the number of takeways between waves 5 and 6 as predictor of and risk of overweight (adjusting for deprivation).**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **OR/beta** | **Lower CI** | **Upper CI** | **p value** | **n** |
| **Model 6: LSOA** | |  |  |  |  | 6784 |
| Outcome | Wave 6 Overweight/obesity | | |  |  |  |
|  | Change in count | 0.97846 | 0.94594 | 1.0121 | 0.207 |  |
|  | IMD Q1 | 2.15152 | 1.8074 | 2.56116 | <0.001 |  |
|  | IMD Q2 | 1.85215 | 1.5469 | 2.2175 | <0.001 |  |
|  | IMD Q3 | 1.52537 | 1.2692 | 1.8332 | <0.001 |  |
|  | IMD Q4 | 1.17445 | 0.97321 | 1.4173 | 0.094 |  |
|  | IMD Q5 | Reference |  |  |  |  |
| Outcome | Change in count |  |  |  |  | 7151 |
|  | IMD Q1 | 0.22794 | 0.11265 | 0.34322 | <0.001 |  |
|  | IMD Q2 | 0.214477 | 0.09594 | 0.33301 | <0.001 |  |
|  | IMD Q3 | 0.05708 | -0.06195 | 0.17612 | 0.347 |  |
|  | IMD Q4 | 0.02163 | -0.09558 | 0.13884 | 0.718 |  |
|  | IMD Q5 | Reference |  |  |  |  |
| **Model 7: Local Authority** | |  |  |  |  | 6784 |
| Outcome | Wave 6 Overweight/obesity | | |  |  |  |
|  | Change in count | 1.00041 | 0.99964 | 1.00118 | 0.3 |  |
|  | IMD Q1 | 2.1327 | 1.7916 | 2.5388 | <0.001 |  |
|  | IMD Q2 | 1.83357 | 1.53116 | 2.1957 | <0.001 |  |
|  | IMD Q3 | 1.5212 | 1.2657 | 1.8282 | <0.001 |  |
|  | IMD Q4 | 1.1746 | 0.9733 | 1.4175 | 0.093 |  |
|  | IMD Q5 | Reference |  |  |  |  |
| Outcome | Change in count |  |  |  |  | 7151 |
|  | IMD Q1 | 9.15678 | 4.2785 | 14.035 | <0.001 |  |
|  | IMD Q2 | 13.3319 | 8.3159 | 18.3479 | <0.001 |  |
|  | IMD Q3 | 4.536 | -0.5010 | 9.573 | 0.078 |  |
|  | IMD Q4 | -0.5227 | -5.4825 | 4.437 | 0.836 |  |
|  | IMD Q5 | Reference |  |  |  |  |
| \*No association between Quintiles and LSOA change | | | | |  |  |

Logistic regression was used to model overweight. Where the change in count was the outcome variable, we used a linear OLS regression model as the outcome was normally distributed (converting the data to a categorical variable for ‘increased’, ‘no change’ and ‘decreased’ produced similar results and had poorer model fit.

**Hypothesis 5: Including physical activity and diet in the model does not change the core findings.**

Modelling here follows the same as described in hypothesis 3. For both fast food consumption and physical activity, we modelled each using ordinal regression models.

**Table A7: Results from Structural Equation Models analysing the determinants of overweight in waves 5 and 6 of Millennium Cohort Study (LSOA data for fast food outlets).**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Odds Ratio** | **Lower CI** | | **Upper CI** | | **p value** | | **n** | |
| Outcome | Wave 6 Fast food outlets |  | |  | |  | |  | | 7151 | |
|  | Wave 5 fast food outlets | 1.2066 | | 1.202 | | 1.2111 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 2.1017 | | 1.9466 | | 2.2692 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 2.0057 | | 1.8539 | | 2.1699 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.6421 | | 1.5127 | | 1.78245 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.3633 | | 1.2574 | | 1.4913 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | |  | |  | |  | |  | |
| Outcome | Wave 5 Overweight/obesity |  | |  | |  | |  | | 7101 | |
|  | Wave 5 fast food outlets | 0.99002 | | 0.96343 | | 1.01734 | | 0.47 | |  | |
|  | Wave 5 IMD Quintile 1 | 1.9499 | | 1.6408 | | 2.3172 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 2 | 1.8418 | | 1.5434 | | 2.1979 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 3 | 1.6214 | | 1.3575 | | 1.9368 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 4 | 1.3143 | | 1.0977 | | 1.5735 | | 0.003 | |  | |
|  | Wave 5 IMD Quintile 5 | Reference | |  | |  | |  | |  | |
| Outcome | Days MVPA |  | |  | |  | |  | | 9309 | |
|  | Wave 5 overweight/obese | 1.5065 | | 1.3849 | | 1.6388 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 1.3952 | | 1.2473 | | 1.5607 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 1.4023 | | 1.2468 | | 1.5772 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.4154 | | 1.2583 | | 1.592 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.3227 | | 1.1779 | | 1.4852 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | |  | |  | |  | |  | |
| Outcome | Wave 6 Fast food |  | |  | |  | |  | | 8824 | |
|  | Wave 6 fast food outlets | 0.984 | | 0.9661 | | 1.0022 | | 0.085 | |  | |
|  | Wave 5 overweight/obesity | 0.7922 | | 0.7245 | | 0.8662 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 3.9887 | | 3.5179 | | 4.52249 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 2.5814 | | 2.2716 | | 2.9334 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.852 | | 1.6314 | | 2.1025 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.2946 | | 1.1423 | | 1.1467 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | | | |  | |  | |  | |
| Outcome | Wave 5 Fast food outlets |  | |  | |  | |  | | 7269 | |
|  | Wave 5 IMD Quintile 1 | 3.0313 | | 2.8011 | | 3.2804 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 2 | 2.663 | | 2.45445 | | 2.8893 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 3 | 1.8273 | | 1.6754 | | 1.9931 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 4 | 1.5071 | | 1.378 | | 1.6484 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 5 | Reference | | | |  | |  | |  | |
| Outcome | Wave 6 Overweight/obesity |  | |  | |  | |  | | 8535 | |
|  | Wave 6 fast food Less/never | Reference | |  | |  | |  | |  | |
|  | Monthly | 0.9434 | | 0.80549 | | 1.105 | | 0.47 | |  | |
|  | Weekly | 0.8084 | | 0.674 | | 0.9695 | | 0.022 | |  | |
|  | Days MVPA Every day | Reference | |  | |  | |  | |  | |
|  | 5-6 days | 1.369 | | 1.0839 | | 1.72998 | | 0.008 | |  | |
|  | 3-4 days | 1.610 | | 1.3108 | | 1.9777 | | <0.001 | |  | |
|  | 2 or less days | 2.0387 | | 1.6552 | | 2.511 | | <0.001 | |  | |
|  | Wave 5 overweight/obese | 29.739 | | 26.06 | | 33.937 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 1.4609 | | 1.1791 | | 1.81 | | 0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 1.4104 | | 1.1333 | | 1.7553 | | 0.002 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.1373 | | 0.91178 | | 1.4186 | | 0.254 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.0876 | | 0.8702 | | 1.3592 | | 0.46 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | | | |  | |  | |  | |
|  | Wave 6 fast food outlets | 0.9748 | | | | 0.9459 | | 1.0022 | | 0.085 | |
| Outcome | Wave 6 IMD Quintile |  | | | |  | |  | | 9718 | |
|  | Wave 5 IMD Quintile 1 | 1.75e-08 | | | | 1.17e-08 | | 2.63e-08 | | <0.001 | |
|  | Wave 5 IMD Quintile 2 | 2.92e-06 | | | | 2.07e-06 | | 4.11e-06 | | <0.001 | |
|  | Wave 5 IMD Quintile 3 | 0.0001545 | | | | 0.000151 | | 0.000207 | | <0.001 | |
|  | Wave 5 IMD Quintile 4 | 0.0075 | | | | 0.0059 | | 0.00952 | | <0.001 | |
|  | Wave 5 IMD Quintile 5 | Reference | | | |  | |  | |  | |

Model fit n=9729, AIC = 114123.8, BIC = 114505.5

**Table A7: Results from Structural Equation Models analysing the determinants of overweight in waves 5 and 6 of Millennium Cohort Study (LAD data for fast food outlets).**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Odds Ratio** | **Lower CI** | | **Upper CI** | | **p value** | | **n** | |
| **Model 10: LADs** | |  | |  | |  | |  | |  | |
| Outcome | Wave 6 Fast food outlets |  | |  | |  | |  | | 7151 | |
|  | Wave 5 fast food outlets | 1.00306 | | 1.003057 | | 1.00307 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 1.3402 | | 1.33222 | | 1.3482 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 1.2819 | | 1.274 | | 1.2898 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.1851 | | 1.1776 | | 1.1926 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.1268 | | 1.1196 | | 1.1339 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | |  | |  | |  | |  | |
| Outcome | Wave 5 Overweight/obesity |  | |  | |  | |  | | 7101 | |
|  | Wave 5 fast food outlets | 1.0001 | | 0.9997 | | 1.0004 | | 0.578 | |  | |
|  | Wave 5 IMD Quintile 1 | 1.8916 | | 1.5772 | | 2.2714 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 2 | 1.8088 | | 1.5137 | | 2.1614 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 3 | 1.605 | | 1.3428 | | 1.91846 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 4 | 1.3052 | | 1.0896 | | 1.56339 | | 0.004 | |  | |
|  | Wave 5 IMD Quintile 5 | Reference | |  | |  | |  | |  | |
| Outcome | Days MVPA |  | |  | |  | |  | | 9309 | |
|  | Wave 5 overweight/obese | 1.5065 | | 1.3894 | | 1.6388 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 1.3952 | | 1.2473 | | 1.5607 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 1.4023 | | 1.2468 | | 1.5772 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.4154 | | 1.2583 | | 1.592 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.3227 | | 1.1779 | | 1.4852 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | |  | |  | |  | |  | |
| Outcome | Wave 6 Fast food |  | |  | |  | |  | | 8824 | |
|  | Wave 6 fast food outlets | 1.0008 | | 1.0005 | | 1.001 | | <0.001 | |  | |
|  | Wave 5 overweight/obesity | 0.7892 | | 0.7217 | | 0.8629 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 3.298 | | 2.8846 | | 3.7707 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 2 | 2.3443 | | 2.0603 | | 2.6675 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.7469 | | 1.5379 | | 1.9844 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.243 | | 1.0963 | | 1.4094 | | 0.001 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | | | |  | |  | |  | |
| Outcome | Wave 5 Fast food outlets |  | |  | |  | |  | | 7269 | |
|  | Wave 5 IMD Quintile 1 | 2.8704 | | 2.8538 | | 2.8872 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 2 | 1.9005 | | 1.8886 | | 1.9126 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 3 | 1.5413 | | 1.5312 | | 1.5514 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 4 | 1.4146 | | 1.4052 | | 1.4240 | | <0.001 | |  | |
|  | Wave 5 IMD Quintile 5 | Reference | | | |  | |  | |  | |
| Outcome | Wave 6 Overweight/obesity |  | |  | |  | |  | | 8535 | |
|  | Wave 6 fast food Less/never | Reference | |  | |  | |  | |  | |
|  | Monthly | 0.9434 | | 0.8055 | | 1.1049 | | 0.47 | |  | |
|  | Weekly | 0.8037 | | 0.67 | | 0.9642 | | 0.019 | |  | |
|  | Days MVPA Every day | Reference | |  | |  | |  | |  | |
|  | 5-6 days | 1.3653 | | 1.0805 | | 1.7251 | | 0.009 | |  | |
|  | 3-4 days | 1.6107 | | 1.3113 | | 1.9784 | | <0.001 | |  | |
|  | 2 or less days | 2.0363 | | 1.6531 | | 2.5084 | | <0.001 | |  | |
|  | Wave 5 overweight/obese | 29.783 | | 26.098 | | 33.989 | | <0.001 | |  | |
|  | Wave 6 IMD Quintile 1 | 1.3042 | | 1.0389 | | 1.6373 | | 0.022 | |  | |
|  | Wave 6 IMD Quintile 2 | 1.3261 | | 1.0631 | | 1.654 | | 0.012 | |  | |
|  | Wave 6 IMD Quintile 3 | 1.0966 | | 0.8785 | | 1.3689 | | 0.415 | |  | |
|  | Wave 6 IMD Quintile 4 | 1.0635 | | 0.8506 | | 1.3298 | | 0.589 | |  | |
|  | Wave 6 IMD Quintile 5 | Reference | | | |  | |  | |  | |
|  | Wave 6 fast food outlets | 1.0004 | | | | 0.9999 | | 1.0007 | | 0.069 | |
| Outcome | Wave 6 IMD Quintile |  | | | |  | |  | | 9718 | |
|  | Wave 5 IMD Quintile 1 | 1.75e-08 | | | | 1.17e-08 | | 2.63e-08 | | <0.001 | |
|  | Wave 5 IMD Quintile 2 | 2.92e-06 | | | | 2.07e-06 | | 4.11e-06 | | <0.001 | |
|  | Wave 5 IMD Quintile 3 | 0.00015 | | | | 0.00012 | | 0.00021 | | <0.001 | |
|  | Wave 5 IMD Quintile 4 | 0.0075 | | | | 0.0059 | | 0.0095 | | <0.001 | |
|  | Wave 5 IMD Quintile 5 | Reference | | | |  | |  | |  | |

Model fit n = 9729, AIC = 1111198, BIC = 1111579.

### Additional sensitivity analysis on attrition

Finally, we describe the extent of attrition. Of the wave 5 participants who dropped out before wave 6, 34% were in the most deprived quintile compared to 14% in the least deprived quintile. The uneven split of attrition by deprivation limits our findings. There was less bias observed by measures of fast food outlets. For example, 38% of participants who dropped out where from the highest tertile of fast food outlets for LADs compared to 32% in the lowest.