**Healthcare and Medical Analytics**

**Individual assignment**

**Bernardo Carvalho**

**24/06/2024**

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# Introduction

The objective of this study is to investigate the of habits and education in early childhood and the development of overweight at a later stage in life. We use as a starting point the work from Jensen et. al. where the relationship of cardiovascular risk factors in the parents of the children in wave 1 is compared to the cardiovascular risk factors of the adults in wave 5.

Our goal is to check if the education the children are receiving in school about dieting is showing any effect later in life. We can do this as in the first wave’s assessment we find information about whether the children were taught about dieting and the risk of obesity in school.

The article “Life-course trajectories of body mass index from adolescence to old age: Racial and educational disparities” argues that:

“[…] adolescence and young adulthood are critical life stages when excess weight can rapidly accumulate and racial/ethnic or educational disparities emerge, most significantly among recent cohorts of young people. These cohort increases in the prevalence and rate of increase in obesity have alarming consequences for contemporary epidemiologic conditions such as the COVID-19 pandemic and US population health and life expectancy in years to come.” (Yang et. at, 2021)

The study, however, concentrates on the social aspects of the children’s upbringing. We will aim to control for these factors, while also investigating other educational factors to see if there are clear actions that could be taken from a public health standpoint that would help to mitigate the risk of becoming overweight at a later stage in life.

# Descriptive statistics

Our dataset consists of the merged data of Wave 1 and Wave 5 questionnaires, with Wave 1 also having information about the family context. The main dependent variable we wish to explain is the BMI of individuals at wave 5. This is constructed from the height and weight values. Then, we have 4 groups of dependent variables:

1. Wave 5: habits
   1. Exercise
2. Wave 1: background
   1. Gender
   2. Ethnicity
   3. Urbanity
   4. Household income
3. Wave 1: baseline health indicators
   1. BMI at wave 1
   2. Self-reported general health
4. Wave 1: Dieting educational factors.
   1. Learned about diet in school.
   2. Learned about importance of exercise.
   3. Learned about obesity in school.
   4. How often they have dinner with parents.
   5. Usual breakfast
      1. Cereal
      2. Fruit
      3. Eggs
      4. Meat
      5. Snack
      6. Bread

Our focus are the dieting educational factors, although we need to try to control for the social background and baseline health at wave 1. The first three variables of question 4 are “binary” variables (excluding the other types of responses that are omitted from our analysis). They come from the following set of questions:

**Please tell me whether you have learned about each of the following things in a class at school:**

the foods you should and shouldn’t eat (H1TS1)

the importance of exercise (H1TS2)

the problems of being overweight (H1TS4)

In these variables we observe an interesting trend. Although we would have expected children to hear about dieting and the importance of exercise in school in high proportions, we see that just over 50% of them have studied topics related to obesity caused problems.

A graph of a question and response

Description automatically generated

Figure 1- Proportion of responses to education questions.

# Regressions

After preparing the data and checking our assumptions on the data distribution, we start fitting a regression model to understand the relationship between the independent variable and the dependent ones. We start with a simple model using all of the variables from our initial assumptions.

In our first regression, we observe expected results like what Yang et. al. had, in which that the main factors for later-life overweight are household income and ethnicity. We also observe that wave 1 BMI is a strong predictor of wave 5 BMI. That is, children have tended to maintain their BMI tendency throughout adulthood. The full result of the regression is available in appendix 1. This baseline model has an adjusted R^2 score of 0.364. For this type of research project, this is a reasonable R^2 score, however, most of the explainability of the model comes from the obvious candidates. However, we observe that regularly consuming meet during breakfast also present a significant value (p<.01). To investigate this trend further, we split the data in two panels: Children who had a healthy BMI (Prentice A. M, 1998) and became obese by wave 5 (BMI > 30) (AllAbout Adult BMI, 2022) and the rest. Our strategy here is to isolate the effect of maintaining the BMI trend throughout adulthood and focus on finding the explanations for BMI in those children who transitioned from one group to the other. The full regression result is available in [Appendix 2](#_Appendix_2_-). In this model, we found an interesting result: Becoming obese throughout life was more prominent on women. The female variable BIO\_SEX:Female had the highest impact on the BMI score with a high significance. Although we must note that the overall explainability of the model (R^2) dropped significantly to 8%. Nevertheless, this is consistent with the data presented in (AllAbout Adult BMI, 2022) that women are more prone to becoming obese these days.

By analyzing the other panel, children who did not transition from a healthy BMI to obesity, we continue to observe the same effects as with the general data, except that we don’t attribute any of the effects to the breakfast habits (see [Appendix 3](#_Appendix_3_-))

Finally, we fit a last set of models that explain the transition from healthy BMI to obese status. To this end, we create a new Boolean variable that encodes the transition, and fit a logit model to it. We start by creating a baseline model, where we only keep the variables that presented the highest impact so far. The results of the baseline model are available in [Appendix 4](#_Appendix_4_–). For this model, we observe a Log likelihood of -2164 and AIC of 4343. We then fit another model adding the “Education” variables, so that we can compare the results.

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Dependent variable:

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w5\_become\_overweight

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BIO\_SEXFemale 0.160\* (0.082)

w1\_ethnicityBlack 0.062 (0.120)

w1\_ethnicityOther -0.150 (0.229)

w1\_urbanityNot completely urban -0.046 (0.081)

w1\_income\_1994\_log\_win -0.569\*\*\* (0.123)

w1\_general\_health\_int 0.074 (0.047)

w1\_learned\_dietYes 0.083 (0.139)

w1\_learned\_importance\_exerciseYes -0.077 (0.176)

w1\_learned\_problems\_obesityYes 0.128 (0.086)

w1\_dinner\_with\_parents 0.002 (0.020)

w1\_usual\_breakfast\_cerealYes -0.071 (0.082)

w1\_usual\_breakfast\_fruitYes -0.217\*\* (0.089)

w1\_usual\_breakfast\_eggsYes 0.068 (0.126)

w1\_usual\_breakfast\_meatYes 0.277\* (0.146)

w1\_usual\_breakfast\_snackYes 0.045 (0.157)

w1\_usual\_breakfast\_breadYes -0.018 (0.089)

Constant 1.030\* (0.607)

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Observations 3,574

Log Likelihood -1,915.189

Akaike Inf. Crit. 3,864.379

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Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 1 – Final Logit model results

Adding the education variables has increased the performance of the fit (although only slightly), but most importantly shed light on the potential importance of the breakfast habits in early childhood.

# Discussion and limitations

In this study, we aimed to bring

Weights (see gender variable for example)

Mode imputation of the exercise variable

Co-founding factors around income, education

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# References

Jensen, T. M., Duke, N. N., Harris, K. M., Hotz, V. J. & Perreira, K. M. (2021) Like Parent, Like Child: Intergenerational Patterns of Cardiovascular Risk Factors at Midlife. *Journal of Adolescent Health.*68 (3), 596-603. 10.1016/j.jadohealth.2020.06.039.

Yang, Y. C., Walsh, C. E., Johnson, M. P., Belsky, D. W., Reason, M., Curran, P., Aiello, A. E., Chanti-Ketterl, M., & Harris, K. M. (2021). Life-course trajectories of body mass index from adolescence to old age: Racial and educational disparities. *Proceedings of the National Academy of Sciences of the United States of America*, *118*(17), e2020167118. <https://doi.org/10.1073/pnas.2020167118>

Prentice A. M. (1998). Body mass index standards for children. Are useful for clinicians but not yet for epidemiologists. *BMJ (Clinical research ed.)*, *317*(7170), 1401–1402. <https://doi.org/10.1136/bmj.317.7170.1401>

*All about adult BMI*. (2022, June 3). Centers for Disease Control and Prevention. https://www.cdc.gov/healthyweight/assessing/bmi/adult\_bmi/index.html

# Appendix

## Appendix 1 – Simple regression, no panel

Simple regression - No changes

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Dependent variable:

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w5\_bmi

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w1\_income\_1994\_log\_win -1.295\*\*\* (0.316)

w1\_ethnicityBlack 0.781\*\* (0.306)

w1\_ethnicityOther -0.352 (0.548)

w1\_urbanityNot completely urban 0.047 (0.199)

BIO\_SEXFemale 0.253 (0.208)

w1\_bmi 0.932\*\*\* (0.023)

w1\_general\_healthVery good 0.513\*\* (0.239)

w1\_general\_healthGood 0.634\*\* (0.279)

w1\_general\_healthFair 0.398 (0.480)

w1\_general\_healthPoor -1.265 (1.957)

w1\_learned\_dietYes 0.418 (0.339)

w1\_dinner\_with\_parents 0.106\*\* (0.050)

w1\_learned\_problems\_obesityYes 0.252 (0.211)

w1\_learned\_importance\_exerciseYes -0.613 (0.431)

w1\_usual\_breakfast\_cerealYes -0.283 (0.203)

w1\_usual\_breakfast\_fruitYes -0.106 (0.216)

w1\_usual\_breakfast\_eggsYes 0.631\*\* (0.317)

w1\_usual\_breakfast\_meatYes 0.749\*\* (0.373)

w1\_usual\_breakfast\_snackYes -0.256 (0.392)

w1\_usual\_breakfast\_breadYes -0.172 (0.219)

w5\_exercise1 or 2 times 0.748 (0.587)

w5\_exercise3 to 5 times 0.346 (0.550)

w5\_exercise6 or 7 times 0.277 (0.602)

w5\_exerciseMore than 7 times 0.640 (0.590)

Constant 12.993\*\*\* (1.729)

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Observations 3,533

R2 0.369

Adjusted R2 0.364

Residual Std. Error 5.819 (df = 3508)

F Statistic 85.394\*\*\* (df = 24; 3508)

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Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

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## Appendix 2 - Panel 1: Children that were not overweight and became overweight.

Panel 1: Children who were not overweight and became overweight

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Dependent variable:

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w5\_bmi

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w5\_exercise1 or 2 times -0.134 (0.857)

w5\_exercise3 to 5 times 0.430 (0.814)

w5\_exercise6 or 7 times 0.196 (0.892)

w5\_exerciseMore than 7 times -0.096 (0.875)

BIO\_SEXFemale 1.724\*\*\* (0.322)

w1\_ethnicityBlack -0.043 (0.453)

w1\_ethnicityOther -0.489 (0.877)

w1\_urbanityNot completely urban -0.224 (0.308)

w1\_income\_1994\_log\_win 0.616 (0.473)

w1\_bmi 0.503\*\*\* (0.076)

w1\_general\_health\_int -0.136 (0.187)

w1\_learned\_dietYes -0.215 (0.533)

w1\_dinner\_with\_parents 0.089 (0.077)

w1\_learned\_problems\_obesityYes 0.036 (0.329)

w1\_learned\_importance\_exerciseYes -0.291 (0.678)

w1\_usual\_breakfast\_cerealYes 0.152 (0.314)

w1\_usual\_breakfast\_fruitYes 0.524 (0.340)

w1\_usual\_breakfast\_eggsYes 0.564 (0.481)

w1\_usual\_breakfast\_meatYes 0.783 (0.536)

w1\_usual\_breakfast\_snackYes 0.090 (0.589)

w1\_usual\_breakfast\_breadYes -0.372 (0.341)

Constant 20.030\*\*\* (2.921)

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Observations 831

R2 0.103

Adjusted R2 0.080

Residual Std. Error 4.319 (df = 809)

F Statistic 4.430\*\*\* (df = 21; 809)

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Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

## Appendix 3 - Panel 2: Children who did not transition

Panel 2: Children who did not transition

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Dependent variable:

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w5\_bmi

-------------------------------------------------------------

w5\_exercise1 or 2 times 0.747 (0.583)

w5\_exercise3 to 5 times 0.603 (0.543)

w5\_exercise6 or 7 times 0.425 (0.595)

w5\_exerciseMore than 7 times 0.975\* (0.584)

BIO\_SEXFemale -0.335\* (0.203)

w1\_ethnicityBlack 0.778\*\* (0.304)

w1\_ethnicityOther -0.187 (0.529)

w1\_urbanityNot completely urban 0.232 (0.195)

w1\_income\_1994\_log\_win -0.598\* (0.314)

w1\_bmi 1.020\*\*\* (0.020)

w1\_general\_health\_int -0.246\*\* (0.115)

w1\_learned\_dietYes 0.587\* (0.329)

w1\_dinner\_with\_parents 0.098\*\* (0.049)

w1\_learned\_problems\_obesityYes 0.025 (0.206)

w1\_learned\_importance\_exerciseYes -0.557 (0.419)

w1\_usual\_breakfast\_cerealYes -0.238 (0.198)

w1\_usual\_breakfast\_fruitYes 0.164 (0.210)

w1\_usual\_breakfast\_eggsYes 0.397 (0.311)

w1\_usual\_breakfast\_meatYes 0.225 (0.375)

w1\_usual\_breakfast\_snackYes -0.483 (0.386)

w1\_usual\_breakfast\_breadYes -0.072 (0.214)

Constant 7.321\*\*\* (1.740)

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Observations 2,702

R2 0.535

Adjusted R2 0.531

Residual Std. Error 4.968 (df = 2680)

F Statistic 146.675\*\*\* (df = 21; 2680)

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Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

## Appendix 4 – Logit baseline model

Logit regression - Become overweight

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Dependent variable:

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w5\_become\_overweight

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BIO\_SEXFemale 0.148\* (0.077)

w1\_ethnicityBlack 0.198\* (0.106)

w1\_ethnicityOther -0.168 (0.216)

w1\_income\_1994\_log\_win -0.648\*\*\* (0.114)

w1\_general\_health\_int 0.005 (0.044)

w1\_bmi -0.055\*\*\* (0.009)

Constant 2.909\*\*\* (0.603)

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Observations 4,014

Log Likelihood -2,164.876

Akaike Inf. Crit. 4,343.752

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Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01