

The Gendered Influence of Environmental Interventions on Childhood Obesity

Introduction and Research Question

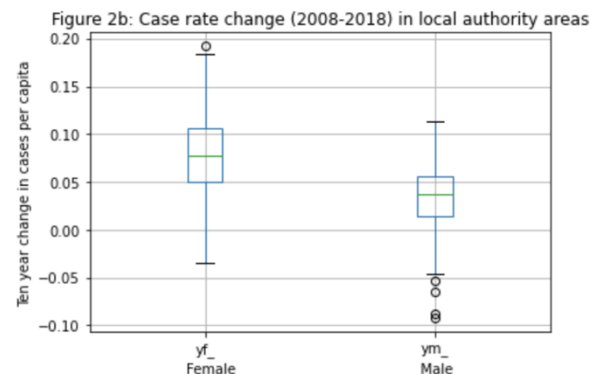
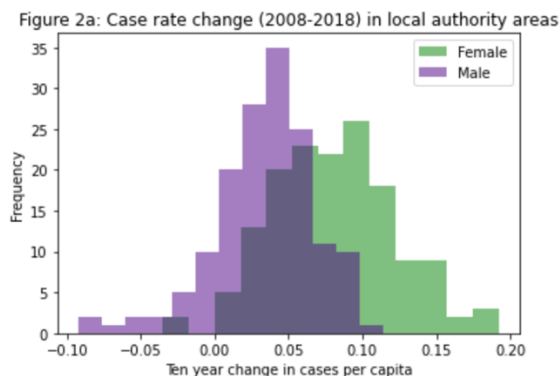
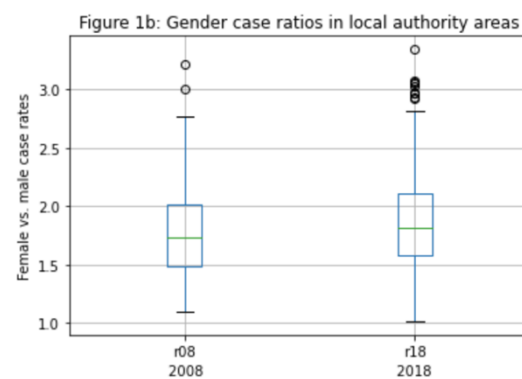
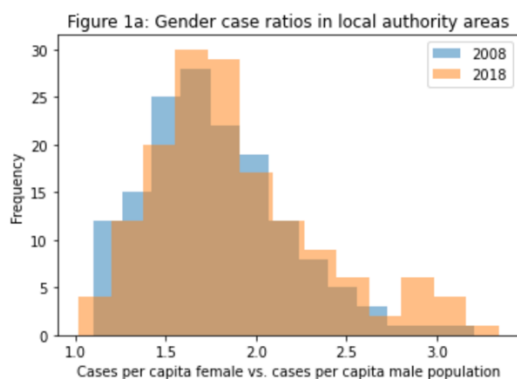
From 2008 to 2018, local authorities across England had funding to address various environmental factors associated with childhood obesity ('Condition X'). Local authorities could allocate their funding amongst six intervention areas. Now, data available from the beginning, middle and end of the ten-year period can shed light on the efficacy of their allocation decisions. Understanding the influence of different interventions, such as for different genders, can guide future funding decisions in communities. This report will address the research question: how do interventions influence the rate of childhood obesity for different genders? Analysis will aim to determine if the influences of interventions on the rate of childhood obesity is the same (null hypothesis) or different (alternate hypothesis) for each gender.

Presentation of Data

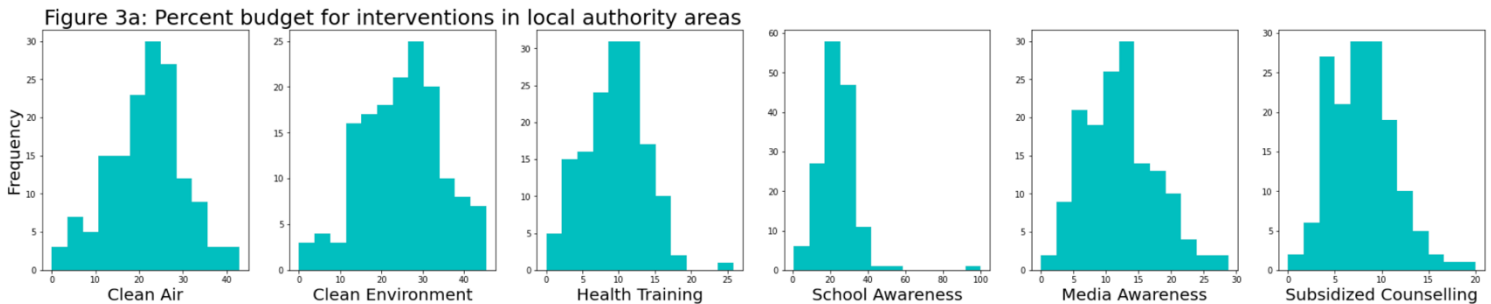
The data analysed in this report originates from the UK Department of Health (2021). The dataset contains information on childhood obesity cases, population, budget allocations, and administrative categories for 152 local authority areas in England. Gendered subsets, for obesity cases and population data, are female or male (no data for additional genders).

Methodology

The following analysis employs Tukey's rule, comparison of means, Pearson's correlation, and simple regression to understand the relationships of intervention and gendered case rates. Three to four significant figures are maintained through the analysis per original data.



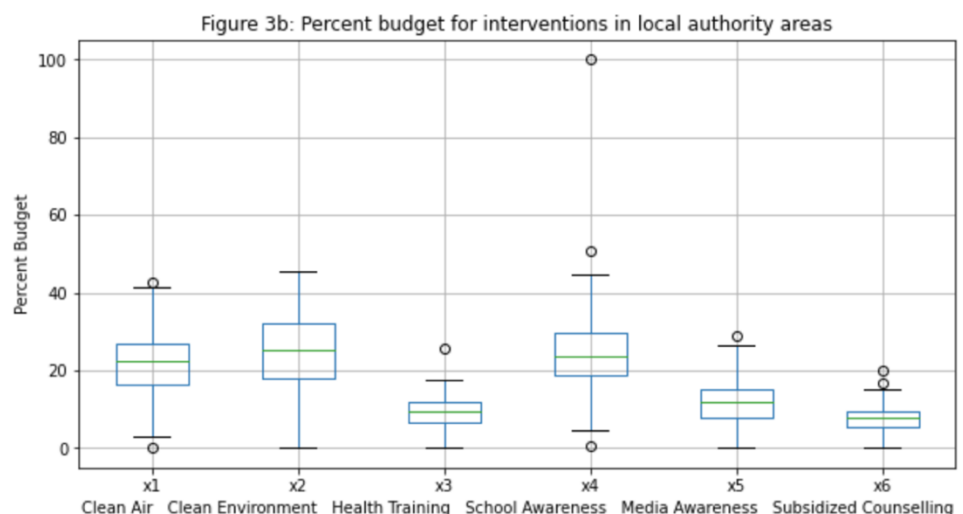
Variables used in analysis are normalised. Two sets of dependent variables are associated with obesity case rates. The first set represents the changes in gendered rates of childhood obesity from 2008 to 2018, where the rates of each year are defined as obesity cases for each gender normalised over the local authority area gender population. A second set of variables represent ratios of female case rate to male case rate over time, where case rate, or case per capita, refers to the normalised proportion of cases in the gender population. The six independent variables are funding allocations for each intervention normalized over the local authority area's total budget. This quantification assumes that funding amount represents the strength and influence of an intervention.



Results and Discussion

Preliminary analysis begins with assessing the normality of the distributions of the dependent and independent variables. Boxplots identify the outliers (symbolised as small circles, defined by Tukey's rule) that appear to skew the distributions visualised in histograms (Figures 1-2). Since the remaining sample size ($n=132$, 86.8% of original) is still sufficient for analysis, and more extreme case ratios and budget allocation patterns may not represent most data, the outliers are removed (code adapted from AskPython, n.d.).

The outliers hint at some trends. In the dependent variables, the outliers tend to represent local authority areas with high female to male case ratios (Figure 1b) or local authority areas exhibiting improved (reduced) male case rates over the ten years of funding. Both these points suggest higher severity of childhood obesity cases in females. In the



independent variables, the outliers seem less patterned (Figure 3); most local authority areas did not allocate more than forty percent of their budget towards any one intervention, although one local authority area allocated all its intervention funds towards school awareness.

Sans outliers, t-tests comparing the means of the dependent variables provide context that support the policy importance of this analysis (code adapted from CASA007, 2021). The first test shows that over the last ten years, the proportion of the female population with childhood obesity compared to the proportion of the male population with childhood obesity appears to be greater, and consistently so; from 2008 to 2018, ratios of 1.735 and 1.793 are not significantly different ($p\text{-value} = 0.1983 > 0.05$ threshold, Figure 1). If this indicates that females have a higher natural tendency for childhood obesity more funding for female-favourable interventions could benefit a larger proportion of obesity cases.

A second test compares how much obesity case rates have changed for both genders over the ten years. Since the female difference, 0.0814 cases per capita, is significantly different from the male change of 0.0407 cases per capita ($p\text{-value} < 0.001 < 0.05$ threshold), case rates can be accepted as having increased more for females than for males (Figure 2). This discrepancy supports the chance that interventions influence gender case rates differently. Should the outliers in the male change in case rate have been included, this discrepancy would have been even greater.

Pearson's correlation further explores this case rate divergence (Figure 4). A statistically significant correlation coefficient of 42.34% implies that female and male case rates from the same local authority area are somewhat, but not strongly, associated ($p\text{-value} < 0.001 < 0.05$ threshold). This less than perfect correlation again implies differential responses to interventions.



Regression determines the predictive strength of interventions for male and female changes in case rates (code adapted from CASA0007, 2021). A scan of scatter plots does not belie apparent linear trends, a condition for regression, nor nonlinear trends, while residuals appear to be independent, normally distributed, and equal in variance (Figure 5). Unsurprisingly, almost all regression results are insignificant ($p\text{-value} > 0.05$ threshold). The only significant regressions are for the Media Awareness intervention in both genders ($p\text{-value} < 0.05$ threshold, Table 1). These results hint that the Media Awareness interventions may influence male and female case rates similarly, but with such low R-sq values, more similar is the lack of linear relationship with any of the interventions.

Table 1: Media Awareness Regression

Response Variable	Female Change in Case Rate (Figure 5: green dots)	Male Change in Case Rate (Figure 5: purple dots)
Linear Model	$y = 0.002x + 0.057$ (Figure 5: red line)	$y = 0.001x + 0.024$ (Figure 5: orange line)
R-sq	6.776%	6.038%
p-value	0.0026	0.0045

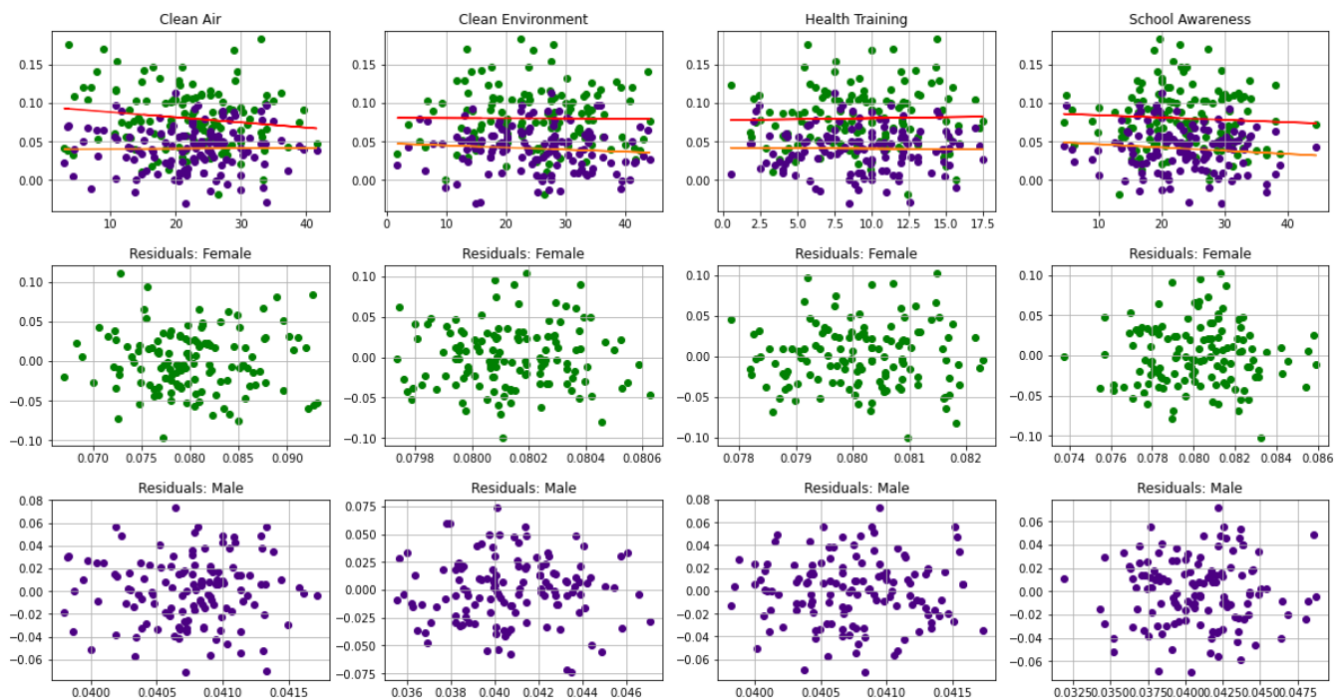
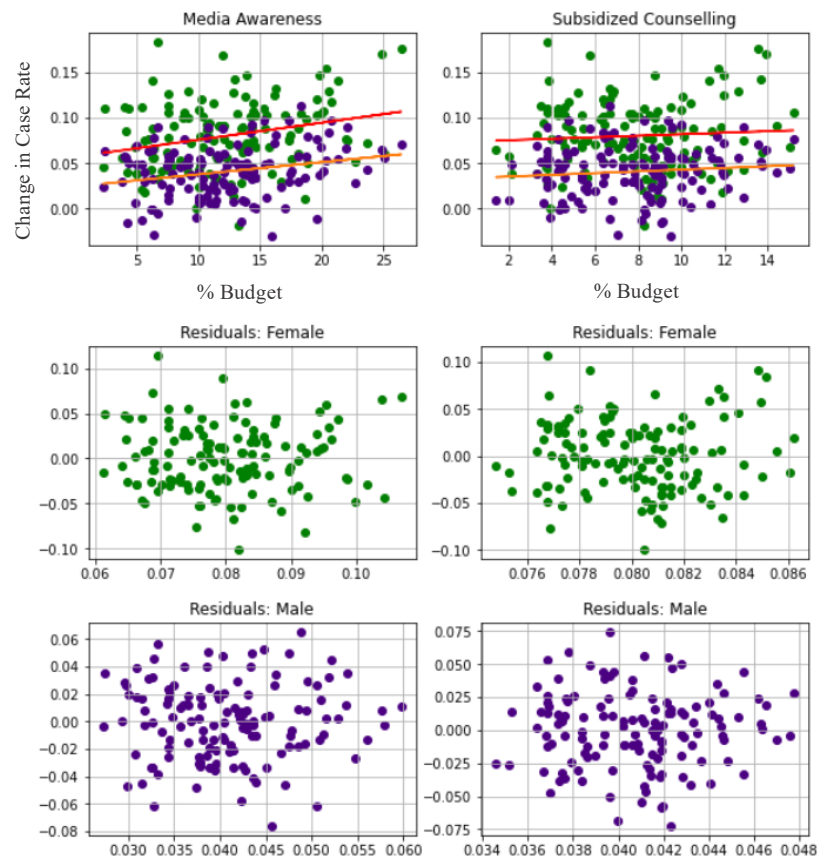
Note: see Github for details and coefficients for insignificant regression plots.

Conclusion

This report yields inconclusive implications for the research question of how interventions influence the rate of childhood obesity for different genders. Comparison of means and Pearson's correlation imply possibilities for differential influences of interventions on the gendered rates of childhood obesity based on the disparities in the ten-year changes in case rates by gender. However, simple regression analysis indicates gender-similar responses to Media Awareness and overall lack of response to interventions.

Future studies may seek to detect the influence of interventions, if any at all, with different variable normalisations and outlier treatments. Perhaps budget percentages do not adequately reflect the influence of interventions. There may also be other factors with stronger trends, such as regions and local authority area type. Ultimately, the relationships between genders and environmental factors should remain a priority in childhood obesity research.

Figure 5: Regression with six interventions and gender change in case rate



Regression axes 'change in case rate' vs. '% budget' are the same as above for Media Awareness.

Reference list

- AskPython (n.d.). *Detection and Removal of Outliers in Python – An Easy to Understand Guide*. Available from: <https://www.askpython.com/python/examples/detection-removal-outliers-in-python> [Accessed 15th November 2021]. (Adapted for Remove Outliers code).
- CASA0007. (2021) Week 3 and 5 Tutorials: Simple Regression. (Adapted for Simple Regression code).
- CASA0007. (2021) Week 5 Tutorial: Hypothesis Testing Toddler Example. (Adapted for Mean Comparison Test (t-test) code).
- Department of Health. (2021) Prevalence of Childhood Obesity, Borough, Ward and MSOA. Available from: <https://data.london.gov.uk/dataset/prevalence-childhood-obesity-borough> [Accessed and modified by CASA007].

Appendix

Code for this analysis can be accessed from this Github repository:

<https://github.com/sunny-netizen/CASA0007-Assignment-1.git>

Word Count (excluding pg. 5): 1084